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PIPE LINE INDUSTRY

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Corrosion Control Report

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Aluminum Line "Launched" Down the Mountain 30

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A GULF PUBLISHING COMPANY PUBLICATION

March 1961 Vol. 14, No. 3

CONTENTS and Quick Look

To help you put first things first, scan these time-saving digest, checking ✓ those you want to read first.

CORROSION CONTROL REPORT

CORROSION—Dollar Saving Ideas and New Trends

☐ Here are some of the latest: Lay aluminum lines which require no protective coatings and "launch" the pipe from mountain tops. Another: Haul molten coal tar from the coke plant and save; this worked in California. Also: Protect in-storage pipe by laying it directly on the ground and protecting it cathodically. The cost of latter is less than the cost of skids normally used.

By Donald M. Taylor.....Page 30

Deep Ground Beds For Cathodic Protection

☐ In the crowded confines of cities, finding locations for ground beds is difficult. But by drilling 250 to 360-foot holes and running a long stalk of bonded rails into it, the effective distance from foreign structures can be increased to make current pick up by foreign structures negligible.

By Sidney E. Trouard and E. A. Wagner, Jr....Page 35

River Crossing Pipe Undergoes Severe Tests

☐ Striving for a near "perfect" submarine river crossing, Columbia Gulf Transmission Company made complete inspection of pipe before construction. Ultrasonic tests for wall thickness, magnetic particle external surface and visual internal surface tests found several sections of pipe that had to be rejected. The dual 24-inch 0.500-inch wall river crossing was buried 40 feet under the Mississippi River near Mayersville, Miss.

By Donald G. De Pugh.....Page 41

Laboratory Studies of Asphalt Coatings

☐ Tests can help to determine the suitability of applications. Here are the results of conductivity tests, disbonding tests, high and low temperature tests, penetration and soil stress tests.

By Pearce R. Butterfield.....Page 45

Epoxy Putty "Glues" Wear Plates onto Gas Line

☐ Advantages of installing wear plates by this means are: First, there is no open space between the wear plates and pipe where moisture can collect and corrosion start. Second, it is easier and safer then welding. Third, the method may insulate the lines electrically if needed for corrosion protection.

By W. R. Bradshaw.....Page 50

Maintaining Microwave in Highly Corrosive Areas

☐ There was so much H_2S in the air that even gold plating was attacked. Many remedial measures were tried; but the solution to the problem of maintaining microwave equipment proved to be a combination of three measures—*sealing*, *cooling* and *filtering*. Selection of equipment helped, too.

By Charles G. Fuller, Jr.....Page 52

An Automatic Firing Line Welder is Here

☐ The new process features a CO_2 gas shield; uses no flux. The pipe is not rotated during a weld and in recent tests it proved highly successful on the right of way. The welds are equal to manual welds in strength. There are no slag inclusions (because no flux is used) and the only off-specification feature of the welds is the small size. Bad weather does not shut the unit down.

By Melvin A. Judah.....Page 26

Keys to the Future of the Pipe Line Industry

☐ Exclusive interviews with top legislative and industry leaders familiar with the Washington scene focused attention on the major issues for the industry in the next four years. Here are their views on natural gas legislation, reorganization of regulatory agencies, area pricing of natural gas, a national fuels policy study, imports, wages and labor and tax policies....Page 55

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Gas facts needed in Washington —and NOW!

THERE'S A LESSON to be learned from the Supreme Court's decision upholding the FPC's denial of a certificate to Transcontinental Gas Pipe Line Corporation to transport gas for Consolidated Edison Company of New York. But first it would be helpful to review just how the case developed. Several years ago Consolidated Edison had arranged to purchase 50 million cubic feet of natural gas a day from South Texas producers. Con-Ed then approached Transco seeking transportation means to get the gas to New York so they could burn it under boilers at an electric generating plant on the East River. Transco filed with the FPC requesting a certificate of public convenience and necessity to build additional facilities and provide this extra capacity in its Texas to New York system, The Federal Power Commission denied the request by over-ruling an FPC examiner's approval of July 1958. Then followed an Appeals Court decision which in effect stated that the FPC had overstepped its authority, and most recently the Supreme Court ruling which said that it hadn't.

In essence here is what the Supreme Court said in its 6-3 ruling: On end use . . .

"One apparent method of preventing waste of gas is to limit the uses to which it may be put, uses for which another, more abundant fuel may serve equally well . . ."

On price effects . . . "As a matter of common sense, it would seem difficult to deny that the channeling of vast quantities of a wasting resource into unregulated transactions at a high price will result in scarcity to other consumers and a general price increase."

And in summary . . . "Neither this court nor the commission holds in this case that sales to pipe lines are generally more in accord with the public interest than other sales; nor do we authorize the elimination of direct sales of gas under appropriate circumstances nor the denial of a certificate to any arbitrarily chosen group of purchasers.

"All we hold is that the commission did not abuse its discretion in considering, among other factors, those of end-use, pre-emption of pipe line facilities and price in deciding that the public convenience and necessity did not require the issuance of the certificate requested. The judgment of the Court of Appeals must be reversed."

The three-justice minority agreed substantially on end use but thought other factors were not sufficient for denial and felt that the case should be remanded to the FPC.

The Supreme Court decision also held that end use "is but one factor and not determinative," and that the function of the FPC was such that it could make judgments as an expert in the field it regulates without being restricted to evidence on the record particularly in regard to future effects on gas prices.

For those of us who are not attorneys, it is difficult to arrive at meaningful conclusions about the effect of the Supreme Court decision on future gas regulation policies. Perhaps the analysis of James P. Henderson, vice president and general counsel of Transco, given recently before the Natural Gas Men of Houston will help to clear the fog. After giving a comprehensive review of the case his important summary concluded:

- "The gas industry can assume that nonjurisdictional sales of gas to be transported in interstate commerce probably will not be permitted.
- "Distributors can anticipate difficulty in getting authorization for gas purchase directly from producers for resale, except in special instances.
- "All segments of the industry can expect to be under regulation, either by states or the FPC.
- "The gas industry should not assume that the FPC will make decisions solely on the recorded evidence; the Court said that a decision may take into account 'policy considerations' or the 'expert knowledge' of the commission.
- "End use of gas may be a factor in commission action on applications for certificates.
- "Considering end use is of course not a new factor (it has been considered as early as 1951), nor does this decision establish a 'National Fuels Policy' by Court fiat.
- "The Con Ed—Transco case does not rule out interruptible sales for the future. For many pipe lines the necessity for these industrial sales is too important in its effect on load factor, economics of line operation, and ultimate consumer prices to be eliminated from the gas pipe line picture."

What does all this mean for the gas industry and pipe line operations? Another degree of regulation has been added to FPC authority, and one open door of relief for the producer and large industrial consumer of gas has been closed, at least for the present.

Further it also emphasizes that the regulation of gas pipe line operations is a complicated and legally sophisticated matter. Language of the Supreme Court ruling includes several terms that are difficult to pin down in relation to precedents for future cases. Some of these meanings in gas regulation are about as "far out" as the scientific space terminology that hits the layman today. And it is going to take some further study to grasp them.

Here is the lesson: These recent developments point up the real need for better industry-government understanding. Industry operations are complex and getting more so; the Federal Power Commission, the courts, and even the new Kennedy administration need the facts. Especially now that they are going ahead with a "National Fuels Study."

Executives of the gas pipe line industry are well informed, capable, and conscientious as any American leaders. **The important thing is to "get the word to Washington" . . . and now before policies are set.**

Special Report to Users of Caterpillar Equipment:

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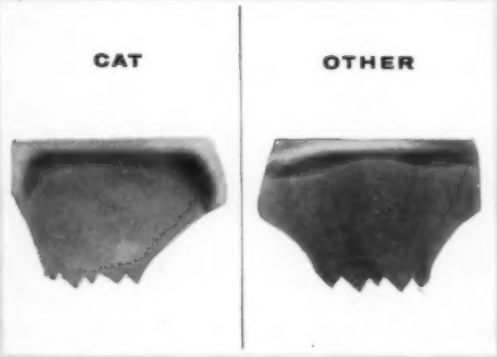
WHAT YOU DON'T SEE CAN HURT YOU

You can buy a lot of parts that *look* like genuine Caterpillar parts. Some may be cheaper initially. But they are as different as night and day when you get them in service.

Take these links, for example. They all *looked* identical when new. But see what has happened after 2000 hours on the same D8 Tractor! The two links in the center, a popular brand with induction-hardened rails, cost about 9% less than Caterpillar links originally, but showed about *50%* more wear.



The extra service you can expect from the Cat links can be seen and compared with other brands. Here are actual photos of etched cross sections of *production* links made by Caterpillar and the other manufacturer. The light areas at top show case depth and pattern of wear-resistant rail material resulting from heat treatment. See the deep, uniform wear case on top *and sides* of the Cat part? It's as hard as a good ball-peen hammer head. But in the other brand, the wear case varies both in depth and hardness . . . that's the reason why after 2000 hours on a D8 the Cat-made links had worn 50% less.

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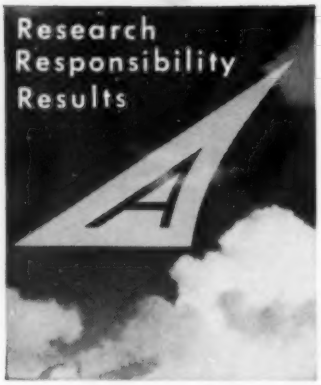

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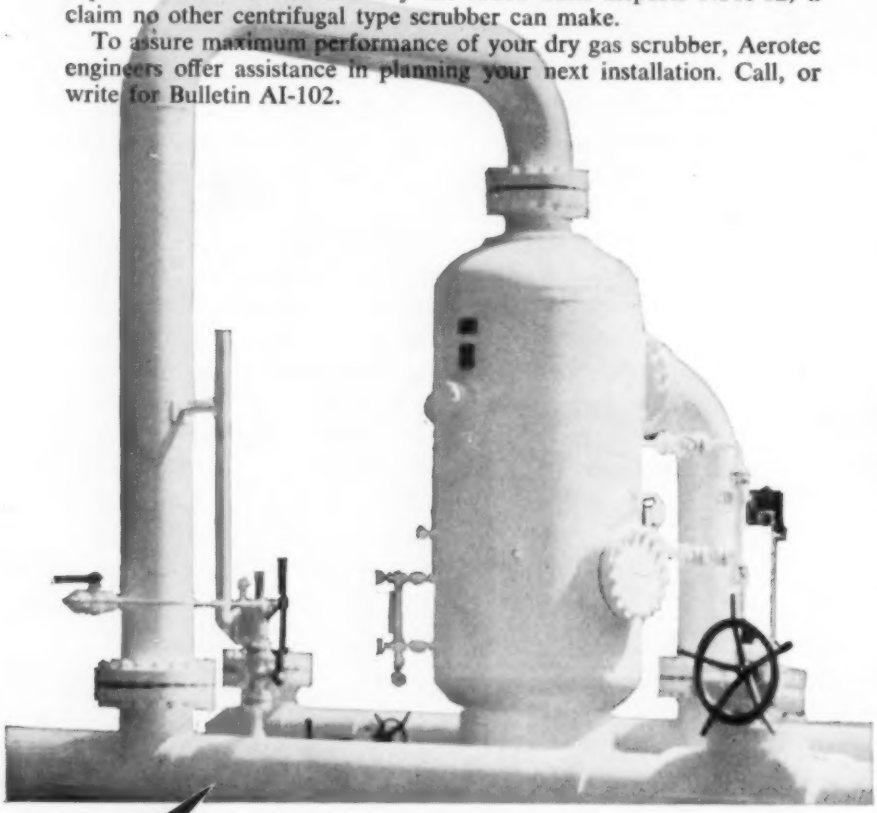

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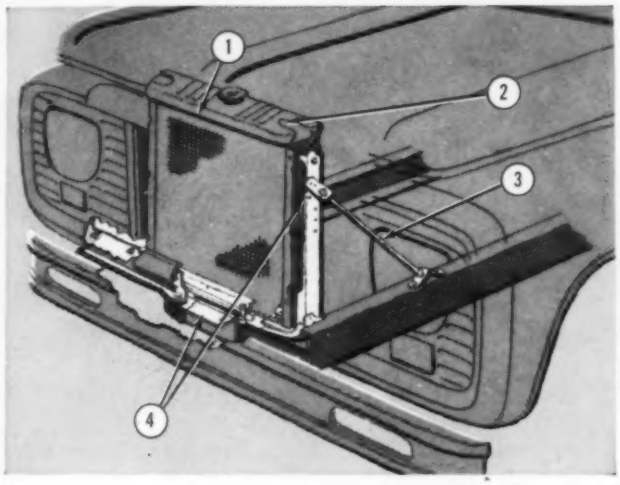

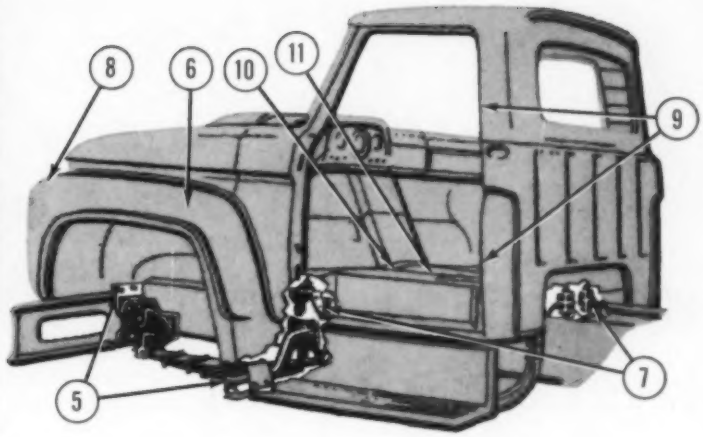

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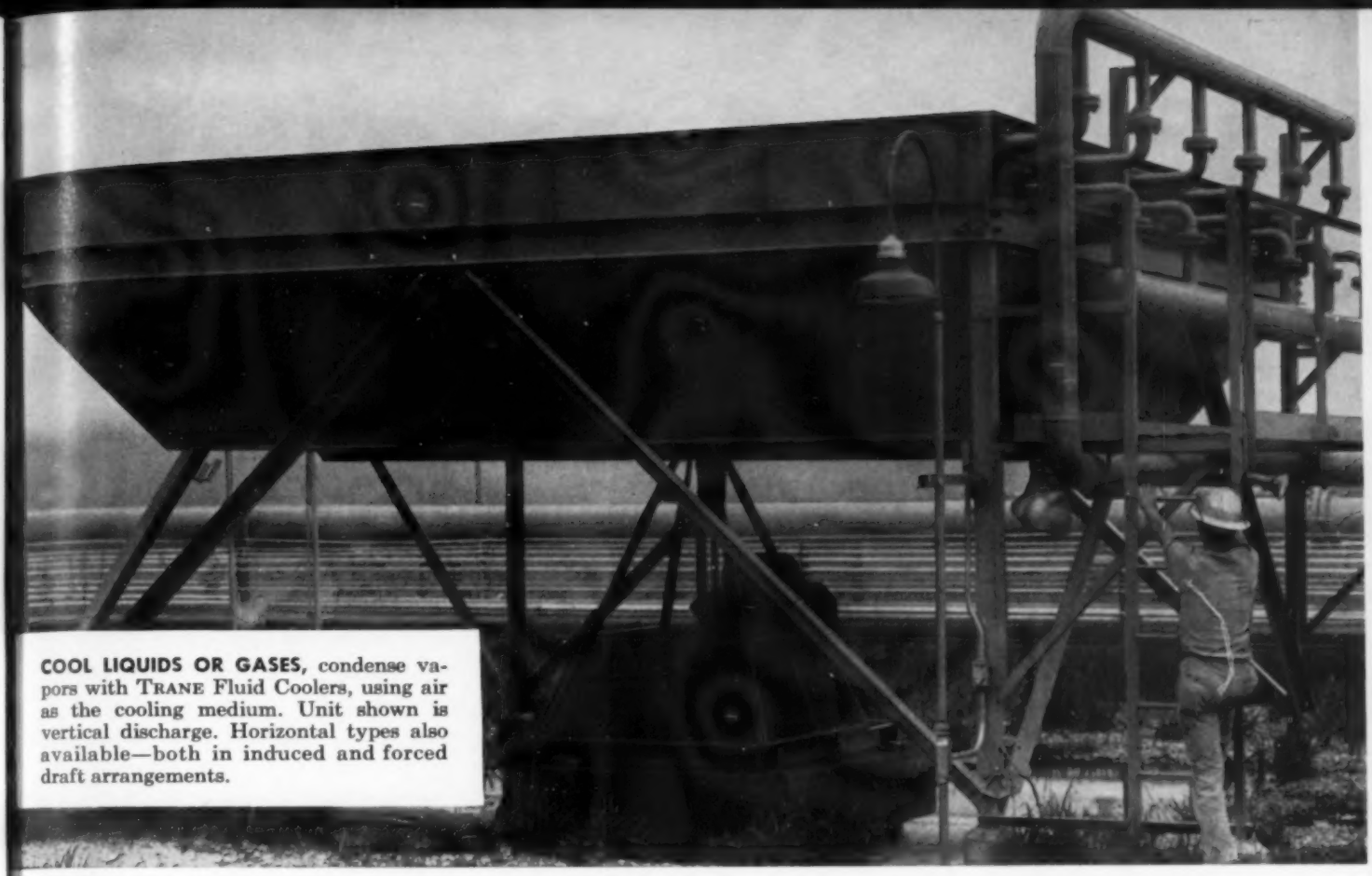

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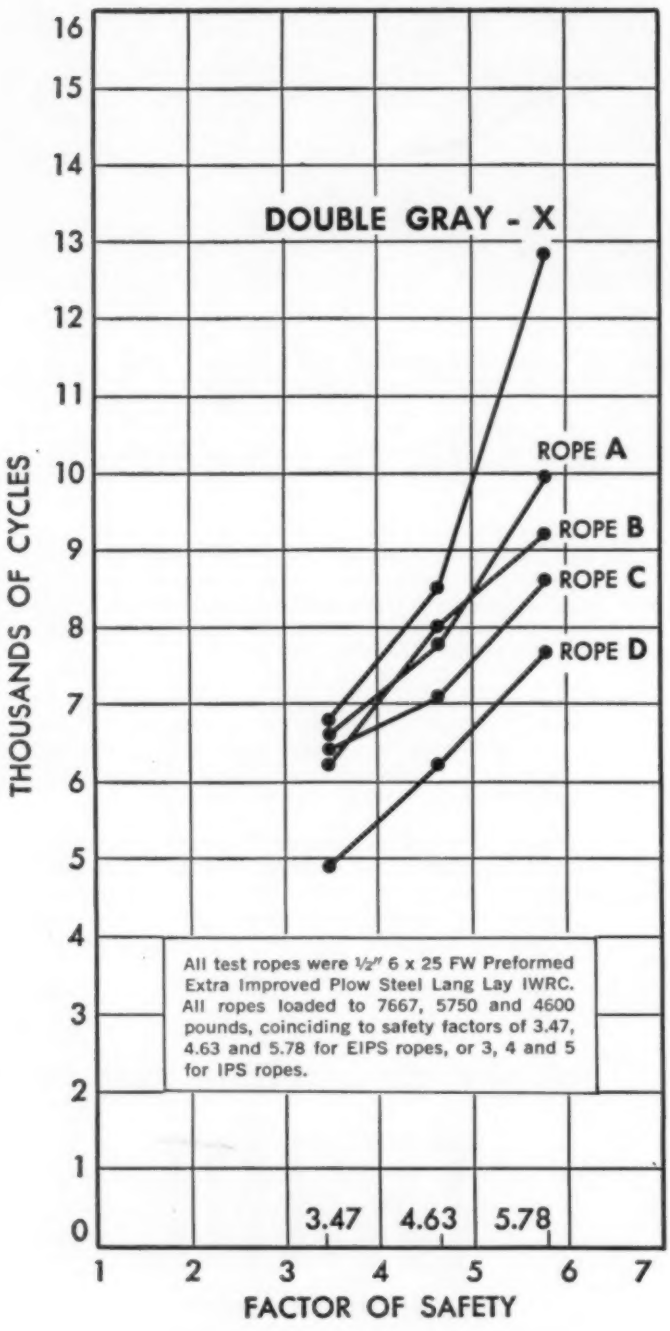
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5.78
All test ropes were ½" 6 x 25 FW Preformed Extra Improved Plow Steel Lang Lay IWRC. All ropes loaded to 7667, 5750 and 4600 pounds, coinciding to safety factors of 3.47, 4.63 and 5.78 for EIPS ropes, or 3, 4 and 5 for IPS ropes.

The CF&I-Wickwire engineers who developed Double Gray-X *believed* in their product. So confident were they of its superiority that they decided to field-test prototypes of Double Gray-X as soon as they were perfected. In the months that followed, the top American firms chosen to participate in these tests delivered this verdict: when the going really gets tough, Double Gray-X lasts longer than other wire ropes.

Now, CF&I presents additional proof that Double Gray-X has *superior resistance to bending fatigue,* the chief enemy of wire rope life. In an extended series of tests conducted over the past year at CF&I's Palmer Plant, Double Gray-X proved itself superior to four other wire ropes, all made by major manufacturers.

HOW WERE THE TESTS CONDUCTED?

The five wire ropes tested—all identical in size and specification — all exceeded the catalog breaking strength of extra-improved plow steel ropes. Each rope was subjected to the same series of tests on a 25,000-pound, multiple-reeved fatigue machine, the largest of its kind. This machine punishes wire rope to destruction by bending it back and forth over sheaves.

*Percentage above average of all other wire ropes tested at safety factor of 5.78

lasts longer

WHAT WERE THE RESULTS OF THE TESTS?

As the chart indicates, Double Gray-X lasted longer than any of the four competing wire ropes at all the safety factors used in the test. At the highest and most commonly-used safety factor, Double Gray-X lasted 30% longer than the rope that lasted next longest, and 68% longer than the rope that lasted the shortest time. Double Gray-X lasted 45% longer than the average of all other wire ropes tested at this safety factor.

WHY DOES DOUBLE GRAY-X LAST LONGER?

It lasts longer because it's the result of a breakthrough in wire-drawing technique. This new process, which includes the use of molybdenum disulphide, creates these outstanding fatigue-resistance factors in Double Gray-X:

- **A Molecular Shield** – Molybdenum disulphide creates a shield around every wire, which serves as a lubricant and prevents the wires from grinding together as the rope operates. Less internal friction results in longer rope life.

- **Smoother Wire Surface** – CF&I's new wire-drawing technique helps eliminate minute surface imperfections in the wire. This smoother surface provides better resistance to fatigue.

- **Extra Toughness** – Molybdenum disulphide lubricates the wires during the drawing process. Since less power is required and less heat generated during this operation, the original toughness of the wires is better preserved.

WHAT CAN DOUBLE GRAY-X DO FOR YOU?

It can save you money. Because Double Gray-X lasts longer on even the toughest jobs, it cuts wire rope repair and replacement costs and rope-installation time. The net result to you is an overall reduction of costly equipment downtime, and a lowering of your total wire rope investment.

As a matter of fact, those of our customers who have already bought and field-tested Double Gray-X have reported considerably longer life and less downtime on their equipment. Join these satisfied customers—try Double Gray-X on *your* equipment right away. Ask your CF&I salesman to give you complete details on these tests.

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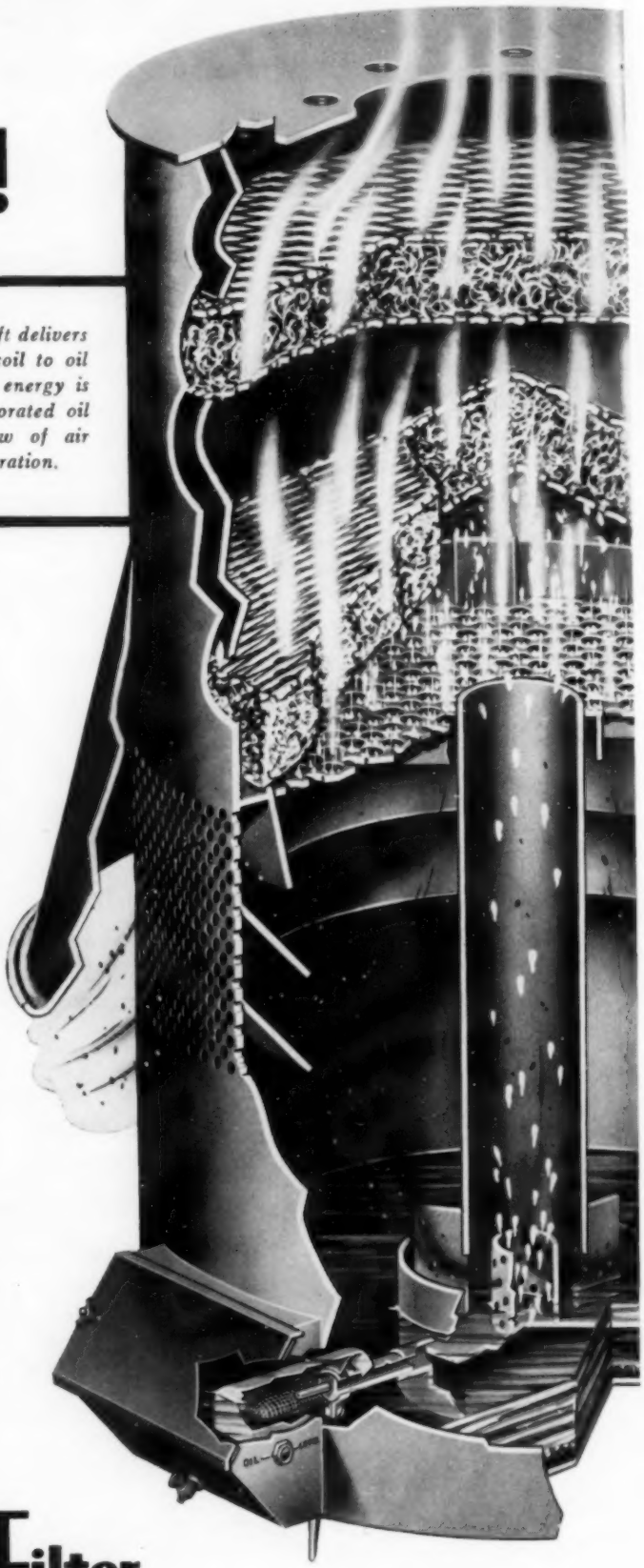
For more data on advertised products, use Readers' Service Cards, last page.

NEW AAF Cycoil air cleaner has no moving parts!

HERE'S HOW IT WORKS—*Pneumatic oil lift delivers oil from reservoir at bottom of Cycoil to oil distribution plate. Source of lifting energy is the static pressure drop across perforated oil distribution plate, resulting in flow of air through plate when Cycoil is in operation.*



Now, an even more trouble-free engine and compressor air cleaner from AAF: the new Type P Cycoil!

Here's the *only* oil-bath air cleaner available which utilizes pneumatic lift, doing away with any need for oil pump and motor. And with pump and motor "designed out" there is nothing to lubricate, no brushes to replace, no circulator to wear out.

Just read these other "plus" features of the new Cycoil:

- **No wiring or on-site power needed; no problems of voltage rating, phase designation, or special protection for hazardous locations. No power bill to pay!**
- **Same low operating resistance and wide range of operation.**
- **Pneumatic oil lift a structural part of the inner Cycoil. No external piping or connections, with their possibility of oil leaks.**
- **Improved method of sludge removal.**
- **Shipped completely assembled. Just provide suitable supports and attach to air intake pipe!**
- ***Absolutely no sacrifice* in the quality of performance and construction which have characterized AAF's Cycoil line for 25 years.**

Interested? Get complete information from your nearest AAF representative, or write direct for Bulletin 160. Address: Mr. Robert Moore, American Air Filter Co., Inc., 450 Central Ave., Louisville, Ky.

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HELPED GET MIDWESTERN PIPELINE INTO GROUND IN A HURRY!

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Ease of pipe preparation and ease of tape application with a minimum of equipment as well as Plicoflex's proven pipe protection make it your best buy in protecting pipe, above or below ground.

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Apply the primer (at prevailing temperature)

Wrap the tape and ditch the pipe. All this in one operation!

Plicoflex protects your pipe because it's—moisture proof • nonconductive • impact resistant • bacteria proof • abrasion resistant • soil stress resistant • chemical resistant.

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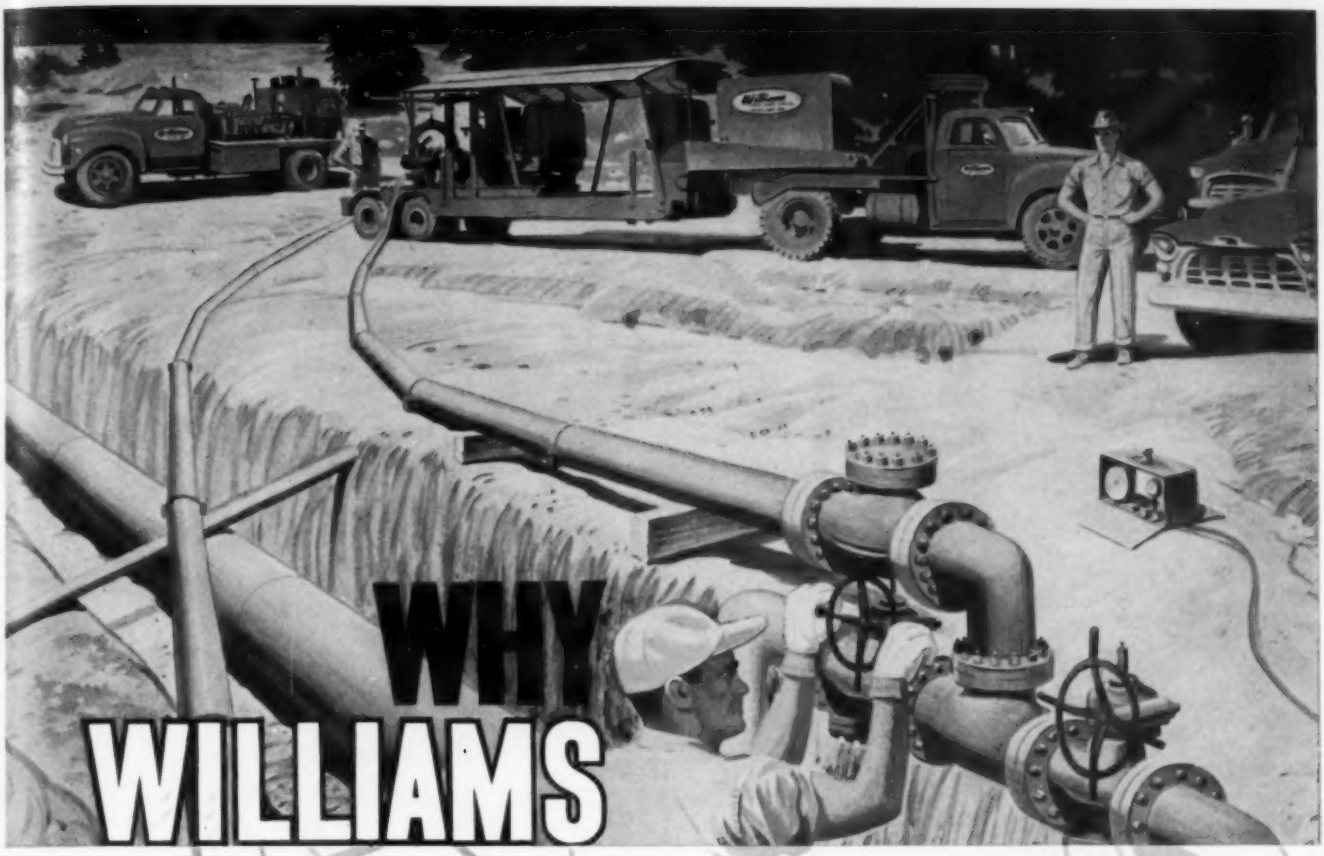

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costs a lot less than you'd think

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There are thousands of miles of reasons for this. For we have hydrostatically tested more miles of pipeline than all other companies combined. Our engineers have learned how to make advance surveys, program the jobs and supervise them personally. There's no lost effort, no added expense. And testing moves right along with construction.

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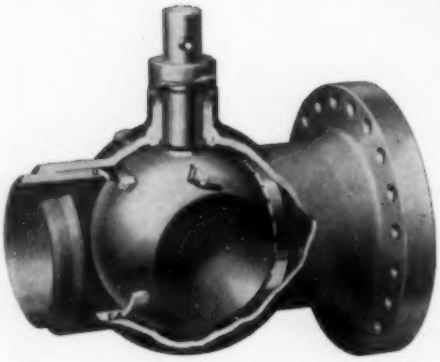
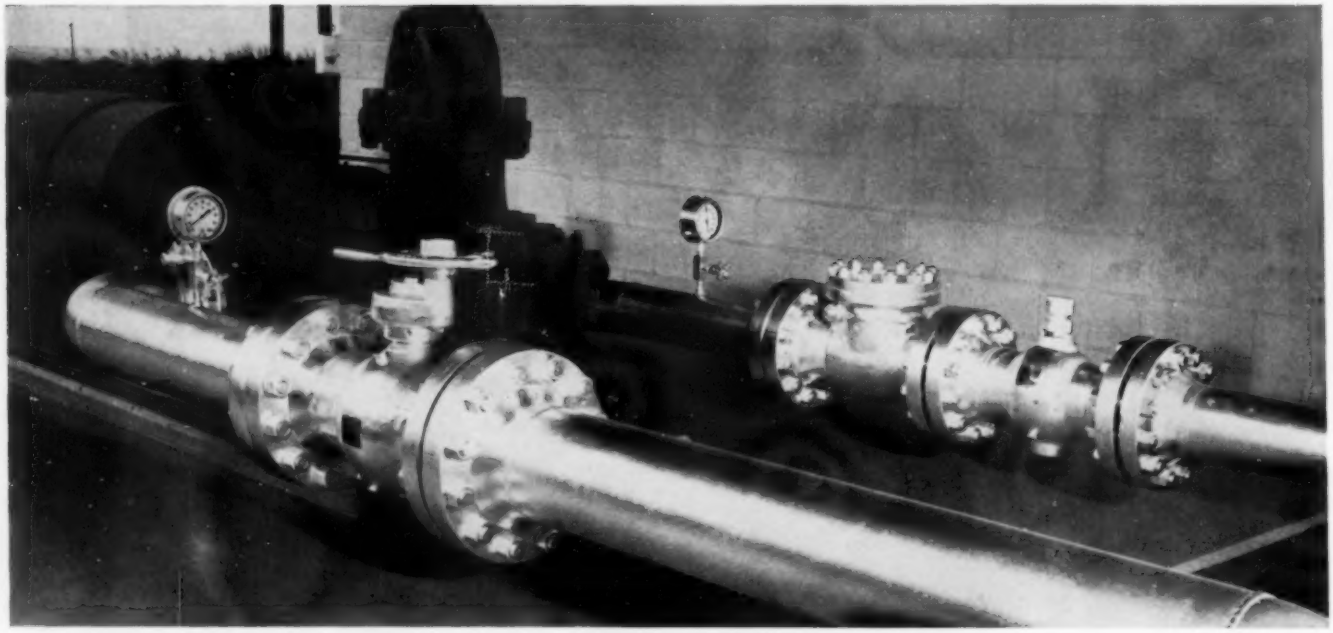
SAY GOODBYE TO VALVE REPAIR



That's right – with Cameron Ball Valves on the job you never need to make repairs. This big step forward in valve design – which makes practical the "sealed for life" construction – is brought about by the exclusive rotating seat principle which has proven so successful in our Type "F" Gate Valves.

Sturdy dogs on the Ball engage gear-like teeth on the Seat Rings to rotate the Seats a fraction of a turn each time the valve is opened. In all valves, maximum wear occurs on the seating surface area which is struck by the erosive blast of line fluid just as the port is uncovered on opening, or just as the flow is being pinched off on closing.



Rotation of the seats distributes this wear equally over the entire sealing surface and extends the life of the valve many times over valves with stationary sealing surfaces.

Also, being non-lubricated, all maintenance costs are eliminated. This means substantial savings in man hours, down time and inventories. Low torque requirements allow smaller operators – less energy on remote controls – easier operation an manual controls. Maximum economy – Maximum service – Mimimum size and weight. Available in sizes 2" to 36" in ASA and API ratings and with any type of end preparation. If you plan, specify or purchase valves, call or write Cameron for complete details.

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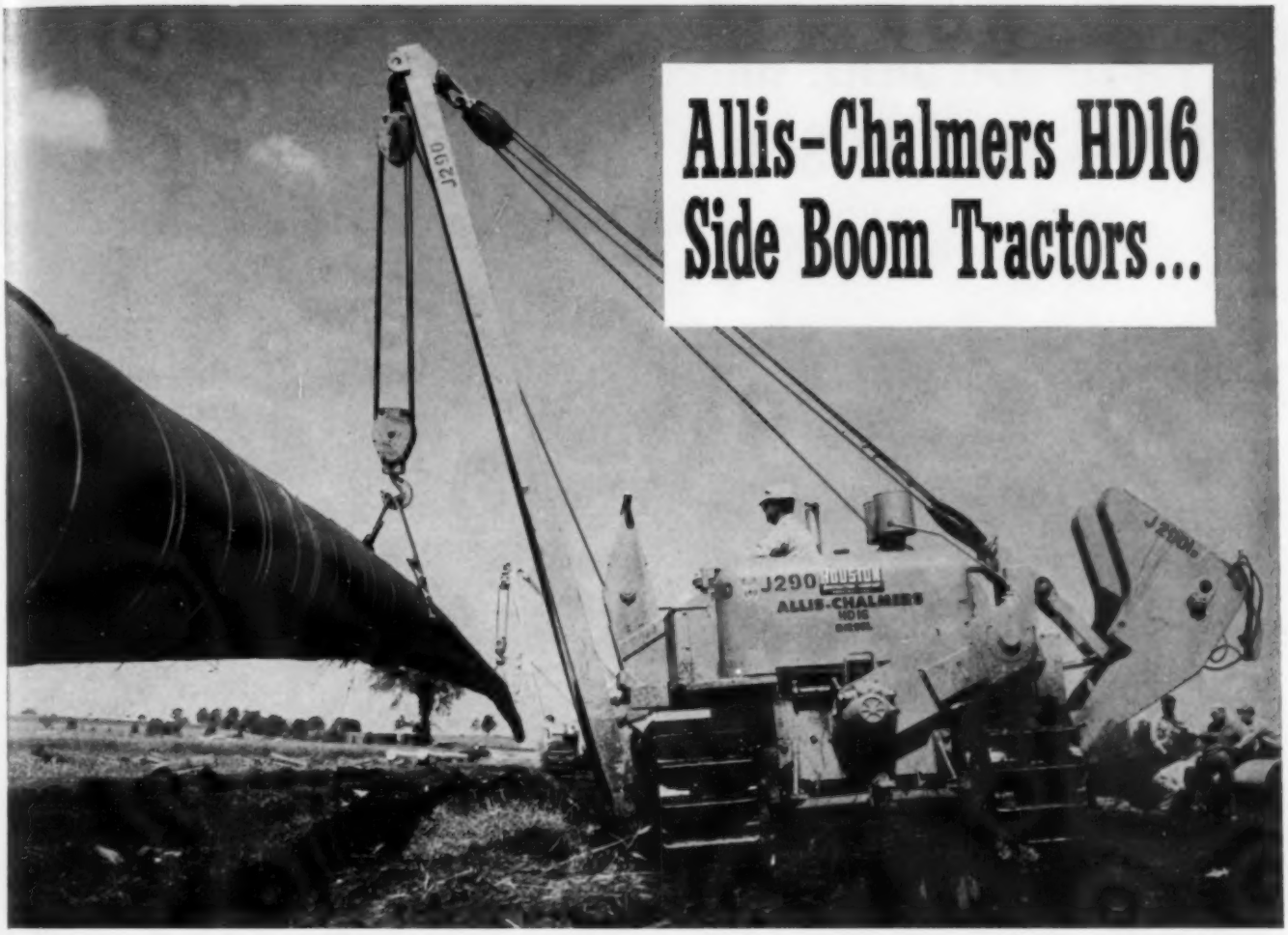

Houston Contracting Company's choice for 24" Michigan-Wisconsin Pipe Line

There's a good reason for one of the leading pipeline construction company's selecting Allis-Chalmers for their job. First of all, the powerful high-clearance HD-16 is the best balanced tractor on the market which means more efficient operation in hilly and boggy terrain. The famous Allis-Chalmers torque converter is standard equipment in the HD-16 FC Boom Tractor and this means easy operation. And when you're laying pipe in hilly and mountainous terrain the Allis-Chalmers HD-16 has plenty of power—not only to pick up a load but to carry it as well. Still another feature of the HD-16 is the Decelerator foot throttle which frees the operator's hands so he can handle the side boom. The HD-16 costs surprisingly little to operate. Its 150 net hp engine can save you up to 27% in fuel over other tractors of comparable size. Permanently lubricated rollers, heavy duty, extra tough tracks keep maintenance costs low on the HD-16.

Call Brown-Fogle and ask to have a demonstration of the HD-16 soon.

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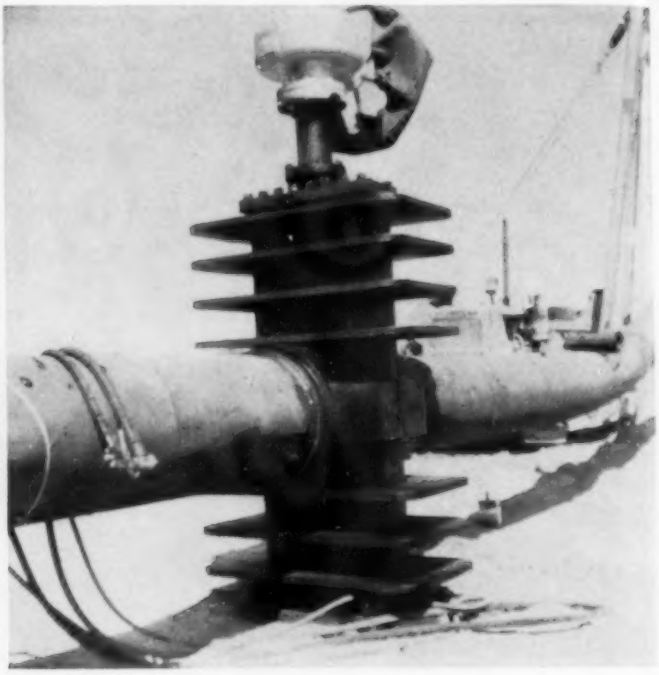
EL PASO NATURAL GAS COMPANY PROTECTS LINE VALVES WITH ROSKOTE COLD-APPLIED MASTIC

Roskote cold-applied mastic was spray-applied to 30" valves by El Paso Natural's personnel at Grants, New Mexico. Risers and support legs were coated with Roskote and wrapped with Royston Glas-Wrap for additional mechanical abrasion protection.



On the El Paso Natural Gas Company line being laid at Fort Stockton, Texas, by Western Pipeline Company, all 20" valves were spray-coated with Roskote cold-applied mastic.

You get superior protection against the most severe field corrosive agents with Roskote cold-applied mastic. Valves, risers, line pipe, tanks and other structures above or below ground are coated with Roskote by spray or brush without heat, flame or toxic and irritating effect on workers. The quick-drying feature of these mastics permits early backfilling. Roskote's time-saving, cost-saving application complements its low first cost to provide you with the most economical means of long-life metal protection.

Roskote is applied cold winter or summer. It retains its plasticity at 0° F, and will not run or sag at 250° F. Its high dielectric strength and resistivity, and its superior resistance to acids and alkalies provides ample protection even under the most rigorous underground or atmospheric corrosive conditions. Specific formulations are available for resistance to high crude oil concentrations and gasoline seepage in surrounding soil.

Royston engineers will give prompt attention to your inquiry.

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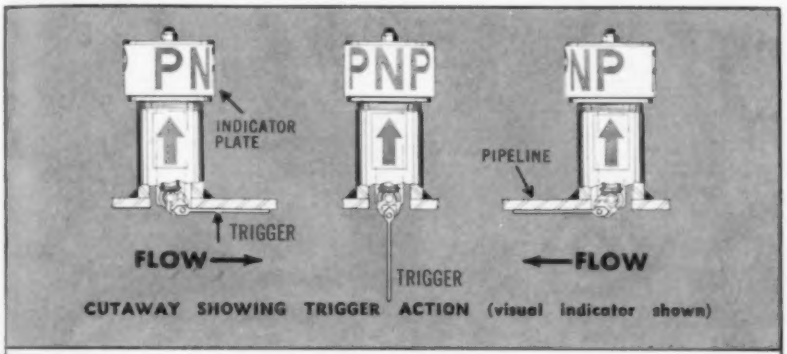
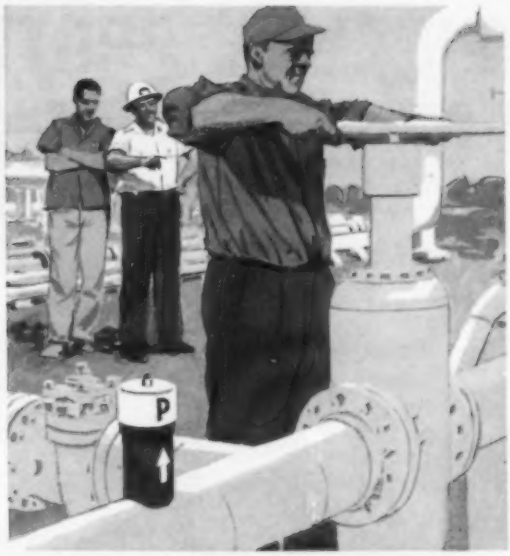
NEWS FROM DOWN THE LINE!

Successful PIG-SIG II
now has NEW BI-DIRECTIONAL TRIGGER
Plus Other Optional Features



CUTAWAY SHOWING TRIGGER ACTION (visual indicator shown)

• The WmSon PIG-SIG II Scraper Passage Indicator which has earned such wide acceptance in the pipeline industry is now available with bi-directional trigger as an optional feature. The trigger is designed for use in lines where scraper travel may be in either direction and in meter proving loops. Other optional features: pneumatic control with automatic reset and automatic counter to record scraper passage.



Long trigger action detects scrapers even in oversize pipe

In the top example, PIG-SIG II with visual indicator shows the station operator the pig has arrived. He doesn't need to wait and listen at the scraper trap. The next example shows how PIG-SIG II with electric indicator can signal arrival of pig to pump station operator. It can start operation of automatic equipment to open and close valves. PIG-SIG II is easily installed under pressure with WmSon-Hillco Tapping Machines. It is available with visual indicator and manual reset; electrical or pneumatic signal with automatic reset; extended or regular.

FOR ADDITIONAL INFORMATION
WRITE DEPT. E FOR BULLETIN A-199-A

PIG-SIG II PATENT PENDING

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PIG-SIG II can be used to actuate pneumatic and electric control systems. WmSon engineers may be able to offer dollar saving tips on its use in such systems. **Contact your representative or the Tulsa office.**

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Ruberoid Asbestos Pipeline Felt

Provides maximum adhesion to preserve pipe coating or enamel in various kinds of soil and soil conditions . . . and to protect against root attack, soil distortion and trench settlement. Economical and long-lasting. Produced in a range of lengths and widths that meets all job requirements. Meets and exceeds specifications of American Waterworks Association and National Association of Corrosion Engineers.

Ruberoid Flexible Rock Shield

Guards piping economically against rock damage... eliminates expensive dirt padding. Can be applied either in two pieces or by the cigarette wrap method. ½" or ¾" steel strapping with aluminum seals or use of scotch filament tapes insures permanent placement. Ruberoid Rock Shield comes up to 60" wide. Is designed for speedy installation. Lighter weight cuts freight cost.

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PIPE LINE PANORAMA

Gas Transmission Deliveries Set New Records . . . Severe winter weather, combined with increased consumer acceptance, boosted gas pipe line volumes to new records in recent weeks. Examples:

Tennessee Gas Pipe Line. Deliveries totaled 30 billion cubic feet during last 10 days of January, for a new record.

Natural Gas Pipe Line. Delivered 12.5 billion cubic feet January 21-January 27—a record one-week send out, and 5 percent above previous weekly high set in December.

Columbia Gas System. Set all-time one-day delivery record December 22—an estimated 4.94 billion cubic feet.

Texas Gas Transmission. Sent out 1.653 billion cubic feet during January 27-28—a record one-day high.

Texas Eastern. Set one-day high of 2.765 billion cubic feet on January 25—and one-week high of 18.879 billion cubic feet January 20-26.

Automatic Field Welding Is Here . . . Esso Research and Engineering has successfully field tested new automatic welding machine that turns out top quality welds every six minutes on six-inch yard coated pipe—with less than one minute needed to make the weld itself (See Page 26). Projected speed down right-of-way is about the same as it takes an experienced pipe gang. Speed in completing circumferential welds runs about 20 times that of manual welding. Unit can be adapted to virtually all sizes of pipe, up to 36-inch, and to almost any wall thickness.

Pipe Lines Prefer Partially Attended Remote Control Operations . . . Latest API study reveals partially attended pump stations increased 23 percent during 1960—unattended operations remained relatively unchanged. Trend appears to be toward reducing attending personnel to one or two, rather than eliminate attendants entirely.

In 1959-60 period, 41 companies reported remote control facilities jumped 51 percent, from 1,427 to 2,155. System-wide telemetering increased 34 percent, from 634 functions to 851.

Pipe Line Briefs . . . Federal Power Commission reports 23 certificates were approved during December, giving go-ahead for construction of 1,150 miles of natural gas pipe line . . . **On January 31, 190 applications were still pending** for 6,588 miles of gas lines and 587,590 compressor horsepower. Estimated cost: $830.7 million . . . **Tennessee Gas Transmission** is taking over Pan American's Bastian Bay, Louisiana, gas reserves. Sale, one of the largest ever made, includes more than 1 trillion cubic feet of reserves. Cost: Nearly $160 million . . . **After announcing 100,000 barrels per day boost in East Coast residual imports during January-March,** Interior Secretary Udall stated, that despite strong arguments to release all restrictions, import controls on residual will continue until he is convinced otherwise . . . **Liquefied Natural Gas Association** has joined other oil and gas groups in supporting an impartial study of nation's fuel resources; and, like the others, expressed concern that study might result in curtailment of consumers' present freedom of choice of fuels . . . **West Coast Transmission's proposed 500-mile, $30 million 12-inch crude oil and natural gas liquids line** from Taylor, B. C., to Kamloops, has received green light from Canadian Government.

Operator checks as automatic welding machine makes a weld on Humble line construction job in West Texas near Odessa. The machine does not require that the pipe be rotated. It uses a CO_2 gas shield instead of usual flux.

Automatic Welding for the Right of Way

This new process produces top quality welds in any kind of weather without rotating the pipe

By Melvin A. Judah
Editor, PIPE LINE INDUSTRY

AUTOMATIC PIPE LINE welding is here!

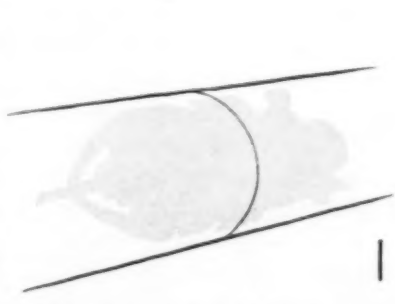
A new automatic welding process developed through Esso Research and Engineering Company proved highly successful in recent field tests conducted on a Humble Pipe Line Company project near Odessa, Texas. Working with the pipe gang, the prototype model of an automatic welding machine based on the new process turned out completed, top-quality welds every six minutes on a six-inch yard coated pipe line.

This speed—good as it is—is not indicative of the machine's true potential. For the welds themselves were completed in less than one minute—the remaining five-minutes-plus was taken up in moving the machine from one weld to another and lining it up to do its work. The developers of the machine say its projected speed down the right of way will be approximately that normally achieved by an experienced pipe gang on any particular size of pipe. Its speed in completing circumferential welds runs about 20 times that of manual welding!

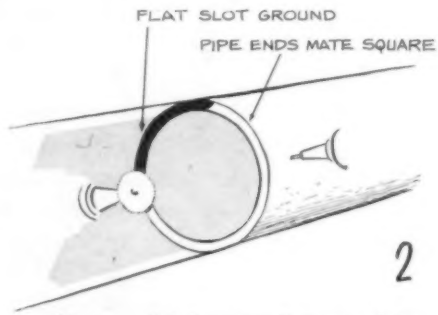
Background. Since World War II engineers and researchers have been trying to develop an automatic welding machine for making the circumferential welds on pipe lines. Some notable successes were achieved in this line of endeavor; and for the past two years, automatic welding machines have been standard equipment in most double-jointing yards. While these machines turn out uniformly high-quality welds, they can never be adapted to cross-country pipelining—they require the pipe to be rotated as the weld is made.

The New Process does away with any need for pipe rotation. M. J. Dabney, head of Esso Research's pipe line research program, describes the new automatic welder as "perhaps the fastest and most practical field pipe welding device in the world."

It is designed for down the right of way operation. It does not require intricate line-up equipment, nor powdered flux and flux recovery equipment. The only requirement in variance with conventional cross-country

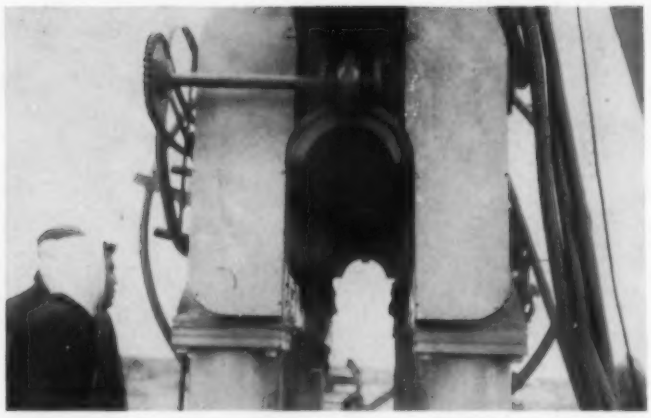


Ends of pipe are butted square; internal line-up clamp does not provide backup at weld line . . .



Narrow slot is ground square into joint from 12 o'clock to 6 o'clock on far side of pipe . . .

Photograph at left shows how the automatic welder is transported between jobs. Welding generator (left) supplies current of 280 amps and 27 volts for welding. It also supplies current for motors in welding machine. CO_2 bottles are at right. The unit also has a compressor which drives the cutting wheel. Right is a pipe's-eye-view of automatic welder. This unit can be converted to 4 or 8-inch pipe in a few minutes. It is necessary only to change the shoes.



practice is that the ends of the pipe have no bevel. The pipe must be square cut at the joint ends.

How the Welds Are Made. The two square cut ends of the pipe are butted together and clamped by an internal line-up clamp that has considerable clearance under the weld area. The automatic welding machine is carefully lined up with the butt ends and clamped in place. From then on everything is preset by automatic controls. An air-driven abrasive cutting wheel grinds a minute sliver all the way through the pipe from top to bottom on one side. A reverse polarity arc welder follows in the narrow track of the cutter and makes the weld. The arc is shielded by a CO_2 envelope, which prevents adulteration of the weld by oxygen in the air. No flux is used.

With half the pipe welded, the cutter wheel once more goes into action, cutting a sliver from the side opposite the weld. This is followed by the arc welder which also moves from top to bottom of the pipe to complete the weld.

The weld is made at high speed. This entire operation, with the exception of moving in and lining up, can be completed in only one minute on 8-inch pipe. This compares with a speed of 20 minutes for a manual weld.

Tests indicate this unit can be adapted to virtually all sizes of pipe up to 36-inch and to almost any feasible wall thickness.

THE FIELD TEST

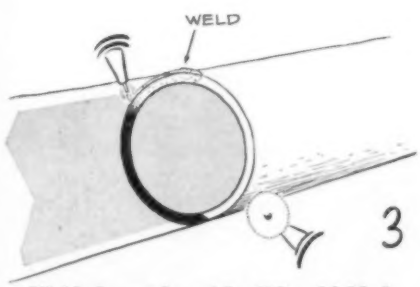
The prototype automatic welding machine shown in the accompanying illustrations welded about one mile of 6-inch, 0.219-inch wall, X-46 pipe on the Humble system. The unit can also weld 4 and 8-inch pipe with no modification other than changing its shoes.

From start to finish, the new automatic welding machine is a piece of precision equipment. In fact, if there is a real secret to its success, it is the precision built into it. At the same time, it is rugged.

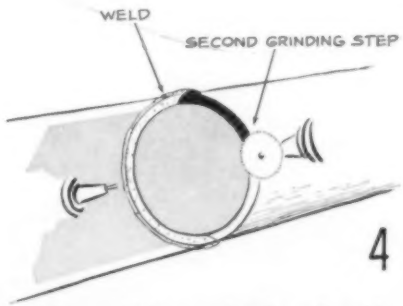
Pipe End Preparation. The pipe on the six-inch Humble line had been pre-coated with the pipe ends left uncoated for a distance of about three feet back from each end of the pipe joints. Aside from squaring off the ends—removing the bevel—no other preparation was necessary.

Lining Up the Pipe. This was a simple matter. The two ends of the pipe were butted together—there was no gap to worry with. Once the two joints were flush, an internal line-up clamp was expanded to round out the pipe and clamp the joints together.

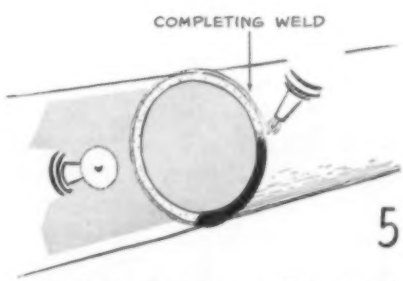
Positioning the Automatic Welder. On this test, the automatic welder was carried from joint to joint by a sideboom tractor. It was set down on the bare pipe at the weld area, and a gunsight-type scope with cross hairs was used by the operator to make the fine alignment adjustments before commencing the weld. Once the machine was lined up, the operator



Weld is made with CO_2 shielded process filling square-cut gap in one pass. Right 180-degree sector of joint remains butted square . . .

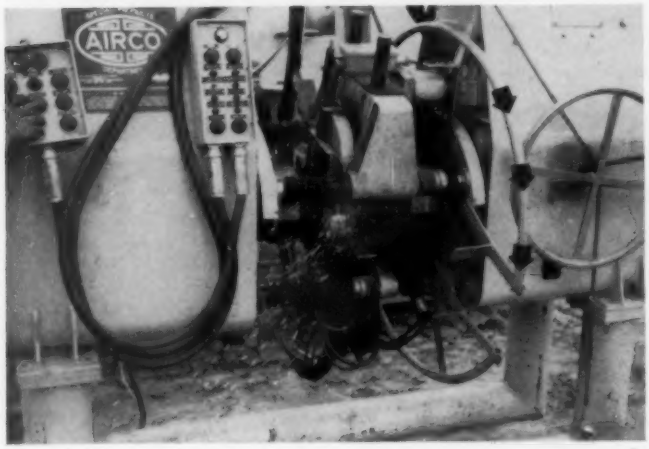


After weld is completed on far side of joint, a narrow slot is ground down the near half of the joint . . .

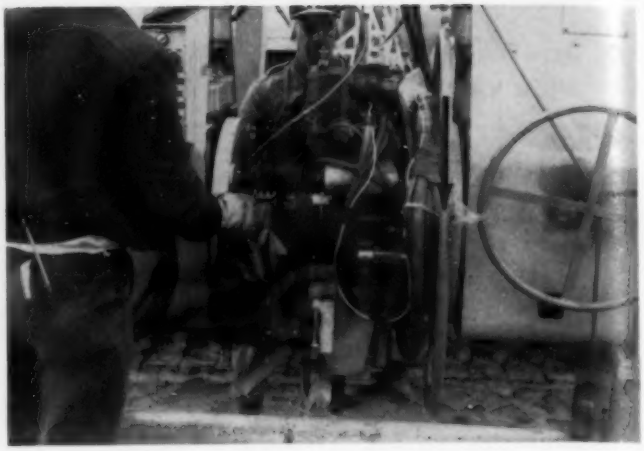


Weld is completed . . . Note that the sprocket linkage keeps the welding head and grinding wheel 180 degrees apart at all steps, even when one is withdrawn from the pipe joint.

Making the weld . . .



STEP 1—The head turns toward us as the cutting wheel bites into the pipe where it is butted together. Cut runs from 12 o'clock to 6 o'clock.



STEP 2—Welding head starts welding from 12 o'clock to 6 o'clock. A CO_2 gas shield protects high temperature metal from oxygen in air.

STEP 3—Machine reverses direction, starts cut on opposite side of pipe from top down. Welding head at bottom moves toward top—not welding at this time.

STEP 4—Welding head goes down on opposite side of pipe, making last segment of the weld. Note the gunsight glass in foreground used by the operator to line up machine.

pressed a button to commence the entire automatic process of making a weld.

Step 1. The pneumatically driven high-speed cutting wheel was spaced 180 degrees from the welding head on the machine, and at the start of this automatic process, the wheel was on top of the pipe with the welding head on bottom. In the first phase of the operation, the cutter wheel bites into the pipe, and starting at 12 o'clock, it cut one-half the circumference of the pipe down to 6 o'clock. The slot it cut was considerably more narrow than conventional bevels and square.

Step 2. As the cutting wheel moves to the 6 o'clock position, the welding head came to 12 o'clock—top dead center. Thus as the cutting finished, the welding head was in position to start the weld. The CO_2 gas shield started flowing around the welding wire at this point and the machine struck an arc with its 280-amp, 27-volt almost conventional welding machine. As the welding head moved from top of the pipe down toward the bottom, it fed its small diameter special alloy wire into the arc at a rate sufficient to give a welding speed of 50 to 60 inches per minute. The machine held an almost perfect gap for the arc, and the finished welds surpassed the strength of the pipe to a considerable degree.

Step 3. With the welding head at the bottom of the pipe and the cutter wheel back at the top, the direction of travel was reversed, and the cutter wheel started taking its second 180 degree slice of steel from the point where the two squared off joints came together. To insure that the weld completely circled the pipe, the cutter wheel bit into the recently completed weld at the top, cuts the pipe steel and ended by cutting into the weld at the bottom of the pipe.

Step 4. This left the pipe with a completed weld on one side of the pipe and a narrow cut on the opposite side of the pipe. At this point the welding head had indexed to 12 o'clock. Once more the machine struck an arc, and welded down the narrow gap, extending a new weld from the old one at the top and tying in to the old weld at the bottom. This

gave a completed weld around the entire circumference of the pipe.

Results of the Tests. While speed in set-up and line-up was not important on this test, the developers of the equipment were highly pleased with progress down the right of way. One operator and an assistant were able to handle the welding machine with ease. All of the engineers and pipeliners who witnessed the test agreed that the new process is feasible for pipe line construction with no further modifications.

Hand Unit. For the novice welder—there was an exciting development exhibited for the first time on a pipe line job. It was the midget gun for the CO_2 process which can be mastered by any non-welder in a few minutes. The unit has an automatic feed for the welding wire; and provides the proper CO_2 shield. The novice welder need only strike the arc and move the unit slowly along to turn out a high-grade weld.

Supplementary Manual Welding Requirements. The automatic welding machine requires no extra manual welding—except for pipe line tie-ins. It will not replace the utility welder. Moreover, it will not be able to weld flanges, close-coupled fittings, etc. The new equipment is strictly designed for cross-country pipelining.

CHARACTERISTICS OF WELDS

The CO_2 welds are unusual in many respects. First, they are free of all slag inclusions, for the simple reason that no flux is used. There are no discernible air pockets, and the strength of the weld actually makes it difficult to get a break across the weld even for testing.

The cross-section of the weld is rectangular—about ⅛-inch wide and running very slightly below and above the pipe. The cap on the outside of the pipe has somewhat the appearance of a stringer bead run from the opposite side of the pipe, although the weld is made by the downhill method.

The welds meet API specifications in every way except for size and shape. But because of the excellent quality of the welds, there is great likelihood that the specifications could be changed. Seemingly, passing with the times will be such right of way specifications as "dime wide and nickel high, etc."

One of the most surprising features of the weld is that the total amount of heat added to the pipe is considerably less than by conventional methods. A minute after the weld is finished, the hand can be brushed across it without sustaining a burn. This makes the machine a natural for cold weather work, and it quite likely eliminates many of the welding stresses that come from the cooling of a triangular cross sectional weld. In this case, the shrinkage of the weld is uniform as it cools.

Pipe gang and firing line rolled into one. Entire operation is similar to the normal operations of a pipe gang. The square cut is butted together and the internal line-up clamp set. Automatic welding machine is positioned. It completes a weld in about one minute and moves to next joint.

The automatic welder is carried from joint to joint by the sideboom tractor. Other tractors are used for cradling. This unit does not require any supplementary welding.

Who Developed the New Machine. While Esso Research and Engineering guided the research and financed its development, others also participated in the project. Battelle Memorial Institute of Columbus, Ohio, cooperated in the research on the new process. Air Reduction Sales Company of Union, N. J., designed and built the prototype automatic welder. Crutcher - Rolfs - Cummings Co. of Houston and Bauer Associates of Calgary, Alta., also participated in the development work.

Air Reduction is completing the construction of a 16-inch model of the machine. Marketing plans are being arranged and are expected to be announced soon.

—The End

Dollar Saving Ideas And New Trends

By Donald M. Taylor, Engineering Editor
PIPE LINE INDUSTRY

BECAUSE OF ITS MANY CHALLENGES, pipelining is an exciting business. For the warm-spirited, there's the challenge of transporting great masses of energy to hungry markets. And many markets remain—yet unsatisfied.

For the adventurous, pipelining provides many challenges—there are wider deserts to cross, taller and more rugged mountains and deeper and wider bodies of water waiting to be crossed.

For the ingenious, pipelining provides a ready outlet for new ideas. In fact, few industries—even the space age ones—give new developments such quick try-outs and patient attention.

In response to such challenges and attitudes, pipe line technology has progressed by leaps and bounds, greatly lowering the costs of completed pipe lines when the spiraling inflation of the past 20 years is taken into consideration.

The new ideas and trends that follow are outgrowths of these challenges and attitudes.

Aluminum Pipe Lines "Launched" from Mountain Tops

United Fuel Gas Company used submarine pipe line construction techniques in laying a mile-long gas gathering line in the mountains of Kentucky. In mid-January, the company "launched" 5,700 feet of 4-inch aluminum line from the tops of two small mountains near Phelps, Ky. An automatic welding machine on the tops of the mountains added joints of pipe onto the end of pipe sections as they were pulled down the sloping right-of-way toward the bottom by a tractor.

This work was carried out in four pulls—two in opposite directions from each mountain top. When the four sections were in place, manual tie-in welds were made and the line was hydrostatically tested and then backfilled.

This method of laying small diameter gas gathering lines in mountainous terrain has several advantages. First, the right-of-way can be narrow because the pipe is not cradled. As a matter of fact, the right-of-way width requirements need scarcely exceed the width of the bulldozer blade that does the grading and back filling. This is highly important in the mountains—especially on the sides of slopes where the amount of dirt handled for a cut increases four times each time the width is doubled.

A second advantage of this method is that less construction equipment is used. In this case, for several sections a shallow ditch was bladed out as the right-of-way was graded, and after the line was pulled and tested, the dirt was bladed back over the line. None of the welding machines, cleaning and wrapping equipment etc. had to make the hazardous trip up or down the steep mountain grades.

Photographs courtesy Aluminum Company of America

The Pipe. This line was constructed of aluminum alloy, scheduled 40-extruded pipe with an outside diameter that varied to increase the 0.150-inch minimum wall thickness to 0.237 inches at the ends of the joints. The minimum tensile strength of the pipe was rated at 38,000 psi.

Most of the ditching was done with a blade, and the side slopes were very gentle. Where trenching was required, the pipe was snaked in after the pulls had been completed.

Visual inspection after the pulls were complete revealed no damage in the way of gouges and scratches from the

dragging. Once the tie-in welds in the valleys had been completed, the pipe was hydrostatically tested to over 1,000 psi—more than twice the working pressure.

No coating was used on the aluminum pipe, and it is to be cathodically protected.

The bare aluminum line is protected by anodes. Anode tabs 1-inch x 1-inch x ¼-inch of alloy 6061-T6 (the same as the pipe) angles were welded to the pipe. Aluminum bolt, washer and nuts secure neoprene covered No. 8 aluminum anode lead wire. The anode leads were attached to the pipe every 250 feet and 17-pound magnesium anodes were installed every 500 feet—10 feet from the pipe and at the same depth.

Soil resistivity at the wells ran 11,400 and 14,250 ohm-cm. At a branch crossed by the line it ran 43,000 ohm-cm. Potential of the two well casings was 0.745 and 0.735 volts.

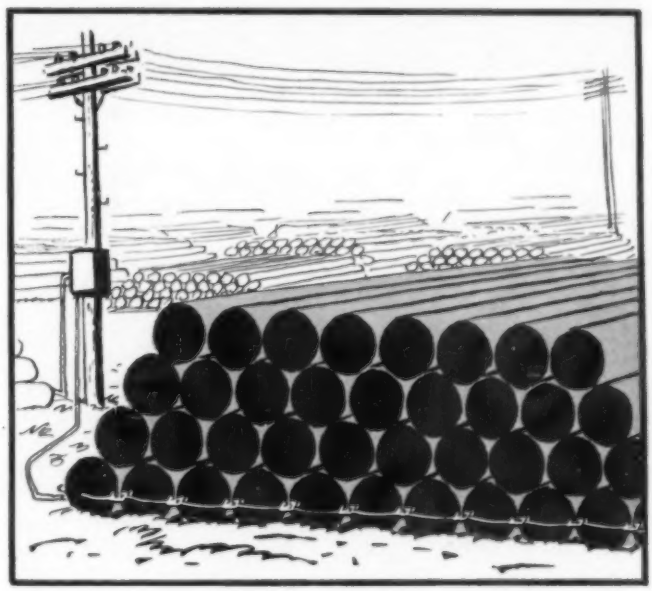
Transco Saves Money By Storing Pipe on Ground and Protecting It

Why use skids beneath the bottom tier of the pipe in storage yards, when you can protect the pipe against corrosion for less than what the skids cost? Anyway, the skids are virtually useless in many areas because the heavy weight of the large diameter pipe usually forces them into the ground when the first rain comes, and the underside of the bottom tier of pipe comes in contact with the ground and needs protection despite the skids.

Transcontinental Gas Pipe Line Corp. took a realistic look at this situation and came up with a plan that has been saving the company money for the past two years. Here's the way it works:

The first tier of pipe is unloaded onto the ground, and the pipe is stacked to normal height—three high for 36-inch; four-high for 30-inch, etc. Cables are strung and attached to each joint of the pipe on the bottom tiers with a "C" clamp. Next, a ground bed—sized to take care of each particular pipe yard—is installed, and the pipe exposed to the soil is cathodically protected.

Everything except the current and ground beds is salvable, so the operation is low-cost. Transco engineers, in fact, estimate its cost at less than that which would normally be expended on skids. After each yard is closed, the cables. "C" clamps, rectifiers, conduit, etc. are taken back into stock.



How does the method work out? Transco has one pipe yard which has been under this type protection for about two years, awaiting construction. The stored pipe is remaining free of "underground" corrosion.

Epoxy Putty Used for Repairing Damaged Concrete Coatings Underwater

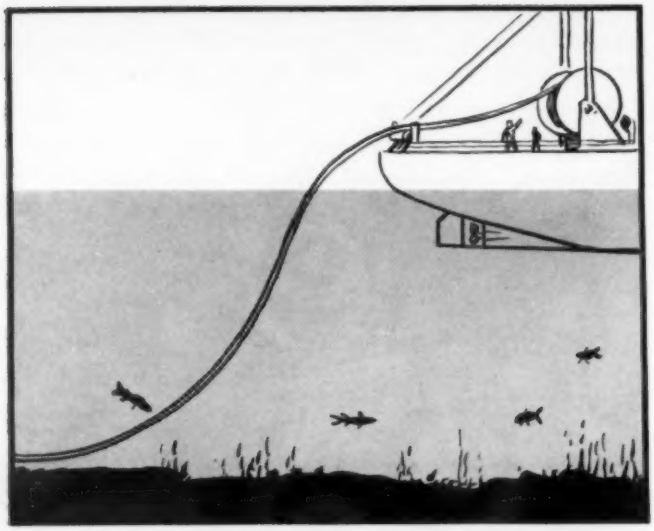
Epoxy putties are finding many uses in the pipe line industry. Not long ago, this material was used to repair a concrete coating on a submarine pipe line in Lake Maracaibo, Venezuela.

When the concrete coating was damaged, it also damaged the protective coating, causing a high current drain.

The solution to the problem was to send divers down with epoxy putty and trowels. In short order, they had repaired the coatings and current drain was lowered.

Two Flexible Pipe Lines Will Be Unreeled Across 18-Mile, 810-Foot Deep Straits

Two submarine pipe lines—deeper than any existing lines—are scheduled to be laid across the 18-mile-wide, 810-foot deep Strait of Georgia by October 1962, to commence deliveries of 45 MMCFD of natural gas to the cities and industries of Vancouver Island in southwest Canada. Flexible pipe will be used for the job and the method of construction will be basically the same as that employed on the World War II Pluto lines which were laid across the English Channel. The pipe will be unspooled from large reels mounted on the stern of a lay-



barge. This is the same technique used in laying deep-sea telephone and telegram cables.

Magna Pipelines Co., Ltd., of Vancouver has awarded a $6,850,000 turn key contract for the lines to British Insulated Callender's Cables, Ltd., which recently laid 11 power cables of somewhat similar construction along the same route.

The British firm owns a subsidiary company that will manufacture the flexible pipe, which will have an ID of 4.85 inches and an OD of 7.5 inches. The pipe will be made up of 18 laminations; the innermost will be plastic to give the pipe a slick interior finish. The next sheath will be made of lead which will provide strength and negative buoyancy. For strength, the pipe will have five reinforcing sheaths of steel tape, four anti-corrosion wraps, a galvanized steel wire armor and several interspersed wraps of jute bedding. The outer three laminations will be bituminized coats for protection against corrosion.

Weight of the pipe will run 51 pounds per lineal foot in air—31½ pounds in water. Its test pressure will be 3,000 psi and operating pressure when each line delivers 22½ MMcf daily will be 1,500 psi.

There is a chance that the 3½ miles of tidal flats on the mainland side will be spanned with rigid pipe laid in a conventional manner leaving only 14½ miles to be crossed with flexible pipe. This decision will rest primarily with the BIC.

This method of laying underwater pipe lines was tried in November 1958, in the Gulf of Mexico by Shell Oil Company. Flexible pipe manufactured by the British company was laid in Block 27 off the Louisiana coast to connect a well to a production platform. The distance was about 900 feet and depth of the water ran about 35 feet. This flexible pipe measured 4½-in. OD and 3.0-in ID. Its weight was 12.2 pounds per lineal foot and its pressure rating was 2,000 psi. The line is now operating at pressures ranging around 1,000 psi.

Shell has since laid additional flexible lines in deeper water where the advantages of the method become more pronounced.

If the plans are not changed, BIC will use three lengths of the flexible pipe of about five miles each in laying each line for the Vancouver project with two splices.

The cities and industries of Vancouver Island are growing, and Ralph K. Farris, president of Magna is planning a third submarine line for construction in 1964. Initially, Magna's customers will be British Columbia Electric Co. which operates a propane-air system in Victoria, the B.C. forest pulp mill at Crofton and McMillan-Bloedel Powell River Co. pulp mill at Hormac. Westcoast Transmission Co. Ltd. will supply gas to Magna.

Polystyrene Pads for Rock Ditches

One new development that holds promise for pipeliners is a new polystyrene pad that can support 20 to 30 pounds per square inch of area. The cost of the pads runs below that of ordinary sand bags which will support equivalent weight.

In rock country, the pads can support the pipe (almost indefinitely if necessary) until the back fill material heals on the under side of the pipe.

The latest development in this field is a proposed plan for a trailer-mounted plant which will produce the pads. This enables the manufacturer to ship bulk polystyrene to the jobsites and expand it to usable volume with heat, etc. Otherwise, the cost of freighting the extremely lightweight blocks long distances runs the cost too high because the freight lines charge for shipment is based on basis of volume, not weight.

Coal Tar Coatings for In-Storage Pipe Are Proving Very Successful

A number of companies have developed coatings for pipe in storage. Some of these are proving highly successful. For example, one pipe line company recently laid pipe that had been given such a protective coating five years earlier. The pipe had been given a 3 to 4-mil coating of a special cold-applied coal tar to protect it against the salt-laden Gulf breezes that deal harshly with pipe in the Morgan City, La., area.

With no preparation, the coated pipe was welded into the line. The cleaning machine made one pass over the pipe and then it was primed and coated. The bond was as good as that found on other pipe.

SYNTHETIC PRIMERS HAVE ADVANTAGES

One of the new developments is the synthetic primer which will give excellent bond even though it is allowed to stay on the pipe for a week prior to coating.

These are merely tabbed "synthetic" primers by manufacturers and although they are non-coal tar materials, they have excellent compatibility with the coal tar enam-

els. Coatings can be applied over them anytime up to a period of several months; field application has been carried out with excellent results four months after yard priming and research lab tests have done equally well after nine months "curing." These materials can give racked pipe a reasonable degree of protection and still be ready for application of the enamel many months later. Application rates are about the same as for regular primer (400-500 square feet per gallon) . . . but the synthetic primer costs up to four times as much.

Liquid Coal Tar Was Trucked 125 Miles From Coke Plant to Pipe Yard

On Pacific Lighting Gas Supply Company's 34-inch line laid across the Mojave Desert last summer, liquid coal tar was delivered in a hot molten state to the coating yard some 125 miles from the coke plant. Temperature of the material at the coking plant in Fontana, Calif., ranged from 525 to 550° F. In transit, it cooled approximately 6 degrees per hour.

On the longest runs—between Fontana and the Henderson, Nevada, pipe yard—the enamel cooled to 410-450° F, depending on the ambient temperatures. PLGS engineers predict that this is perhaps the limit for hauling without heating en route.

The insulated trucks were able to deliver 52 tons of liquid coal tar each trip. It was found in the early loads that filler dropped to the bottom of the tank and surfaces became coated with solid enamel. This problem was readily overcome by installing agitators inside the tanks.

At the pipe yards, the enamel was transferred to the heated and agitated kettles for direct application to the

80-foot lengths of pipe. On this line the coated pipe was bell-hole welded and the only subsequent coating was at the weld area.

Advanced Research on Coal Tar-Epoxy Thin Coatings

At least one of the leading manufacturers of the thin film coal tar epoxy pipe line coating materials is kicking off an advanced research and testing program to iron out some of the problems of cross country line application. These materials have made an outstanding record in tank and valve coatings, but field applications have not always measured up for cross-country pipe lines. The advanced development program aims to find answers to the following problems for cross-country pipe line use:

- Application temperature control
- Suitable equipment for application
- Evaluation of product characteristics as compared with established hot pipe line enamels
- Relation of the thin films to steel anchor patterns
- Cleaning methods
- Handling of coated pipe
- Inspection techniques—possibly other than high-voltage spark detection
- Underground performance especially under cathodic protection

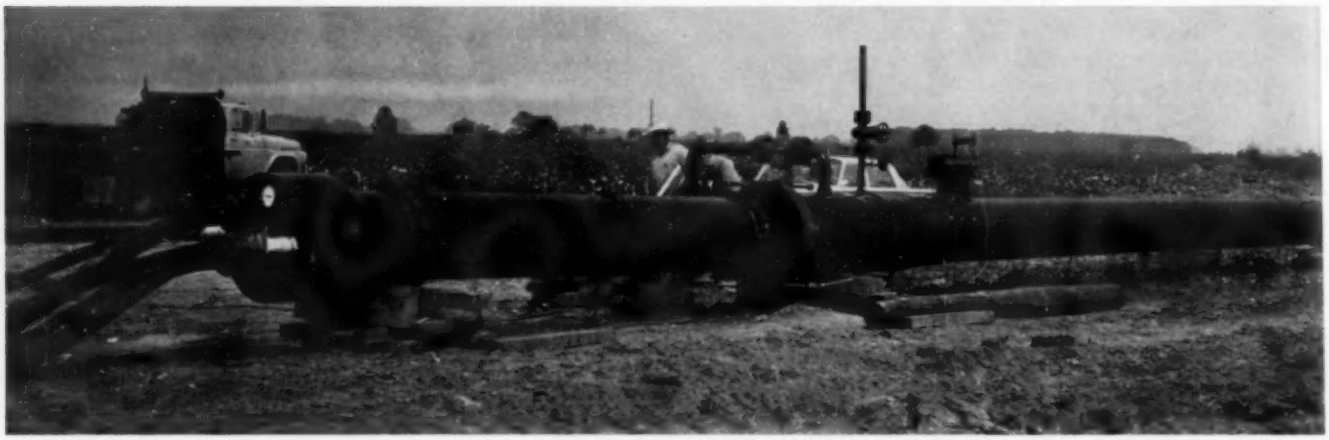
It is significant that the majority of these points center on application techniques rather than the properties of the materials themselves.

Sandblasting Gas Lines in Place to Increase Flow Efficiencies

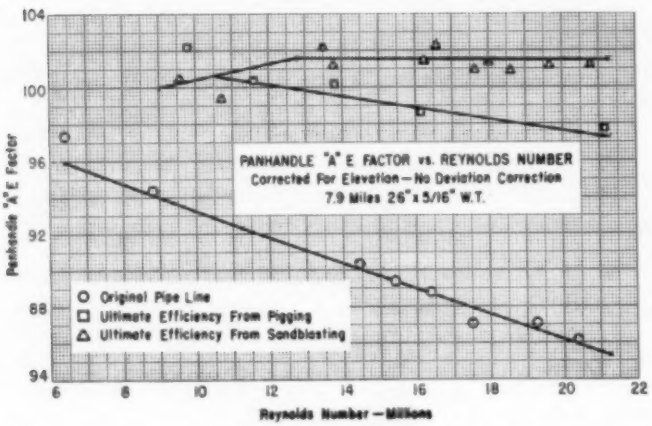
A sizeable increase in gas flow efficiency can be obtained by giving the inside of a gas pipe line a super-cleaning with sand propelled through the line by a high-velocity, turbulent gas stream, according to a leading gas company's engineers reporting on a process developed by Sharman, Allen, Gay & Taylor, Inc. and J. D. McCune of Klean Kote Co. The report claims that Panhandle A Formula "E" factors were increased from the low 90's to about 101 percent. (See page 48, January 1961 PIPE LINE INDUSTRY).

So far, Sharman, Allen, Gay & Taylor have cleaned eight sections of large diameter gas lines; three have been 26-inch and five 30-inch, and the length of each section varied from 9 to 11½ miles. The increases in flow efficiencies were uniformly high according to the client's report.

Ready to begin. Truck has 25,000 pounds of sand, about a capacity load for the mixing tank. Pipe line is at left.



Sand and high-pressure gas enter line. Gas flow is about 50,000 cfm for 30-inch. Sand was injected in 5,000-pound slugs.



Test results on a section of 26-inch gas transmission line. Line was cleaned with mechanical pigs first, then sandblasted.

Dirty sand pouring from open end of pipe gives indication of dirt, rust, oil, water, etc. picked up by high-velocity, turbulent sand.

How the method works. A dense flow of sand is injected into a high-velocity gas stream (about 50,000 cubic feet per minute for 30-inch pipe) and exhausted to atmosphere at the end of the section to be cleaned. Apparently, the sand impinges against the sides of the wall repeatedly as it shoots through the pipe line.

As a rule, the developers have been using from 25,000 to 50,000 pounds of sand in cleaning each section of line; this depends on the characteristics of the line interior. The sand is injected into the line in slugs, and thus far, it has proved able to remove dirt, rust, oil and even water. (Where the liquids are present, additional sand is required as a rule.)

The sand is blown out the opposite end, although it is considerably finer at the end of the run than at the beginning. A finely divided deposit is sometimes left around the circumference of the pipe, but its removal is pointless because the sizable increase in velocity required to do the job is far beyond the velocity of normal gas flow.

While length of sections of line in the past have been limited, Sharman, Allen, Gay & Taylor feel the length of sections can be greatly increased. **The End**

Deep Ground Beds Solve Congested Area Corrosion Problems

One solution to current pick-up by foreign structures

By **Sidney E. Trouard,**
Corrosion Engineer, **and**
E. A. Wagner, Jr., Engineer
New Orleans Public Service, Inc.,
New Orleans

IN THE CROWDED confines of a large city, one of the vexing problems facing a corrosion engineer is that of finding suitable locations for ground beds. If they are close to foreign structures, a sizable portion of the current is lost to the structures as shown in Figure 1. But this effect, known as the anode effect, can be rendered so small as to be undetectable by placing the ground bed at a great distance from the foreign lines. This is difficult to accomplish in cities where there are networks of foreign lines.

One solution to the problem was originally suggested in 1951 by Robert J. Kuhn, New Orleans corrosion consultant. In collaboration with Kuhn, Public Service designed a deep rail ground bed, the first of which was installed in New Orleans in 1952.

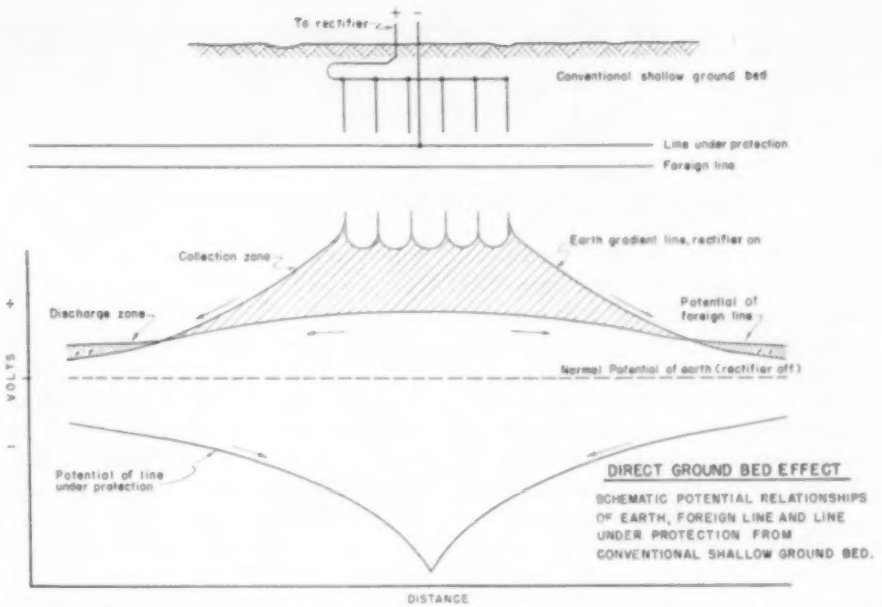

To rectifier
Conventional shallow ground bed
Line under protection
Foreign line
Collection zone
Earth gradient line, rectifier on
Discharge zone
Potential of foreign line
Normal Potential of earth (rectifier off)
VOLTS
Potential of line under protection
DIRECT GROUND BED EFFECT
SCHEMATIC POTENTIAL RELATIONSHIPS OF EARTH, FOREIGN LINE AND LINE UNDER PROTECTION FROM CONVENTIONAL SHALLOW GROUND BED.
DISTANCE

FIGURE 1—Problem with shallow ground beds in congested area. Foreign line captures or picks up sizable portion of protection current. One solution is to move the ground bed some distance away.

Today there are a number of other such installations in southern cities.

Three Types of Ground Beds. For the cathodic protection of the coated steel gas main system in New Orleans, three different types of ground beds are employed:

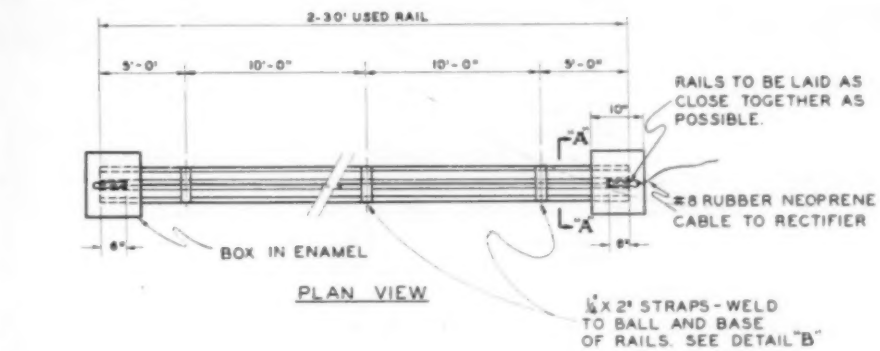


FIGURE 2—Construction details of a shallow ground bed made of rails. Note that both ends, where rails are bonded, are encased in boxing of enamel. Rails also are connected at other points. This arrangement gives 75 percent use of metal.

1. Conventional shallow rail ground bed as shown on Figure 2. Provided a suitable location can be secured, this type of ground bed is generally preferable because it costs less ($250 installed). The used rails weigh about one ton, and such a ground bed is designed conservatively for a 10-year life with a 5-ampere current discharge. This is based on the assumption that only half of the metal will go into solution; the rest lost by segregation. Actually, the thin webs of the rails discharge little current because of mutual interference effects. Thus 75 percent of the metal is utilized rather than the design figure of 50 percent and the probable life of the ground bed would be longer than 10 years. In 500 ohm cm. soil, the resistance to earth of this type of bed ranges from 0.5 to 1.0 ohm.

2. Deep rail ground bed (Figure 3). In this type of ground bed, a 9-inch hole is drilled in the earth to a depth of 250 to 300 feet. Two 30 foot lengths of 100 lb/yard used Tee rails

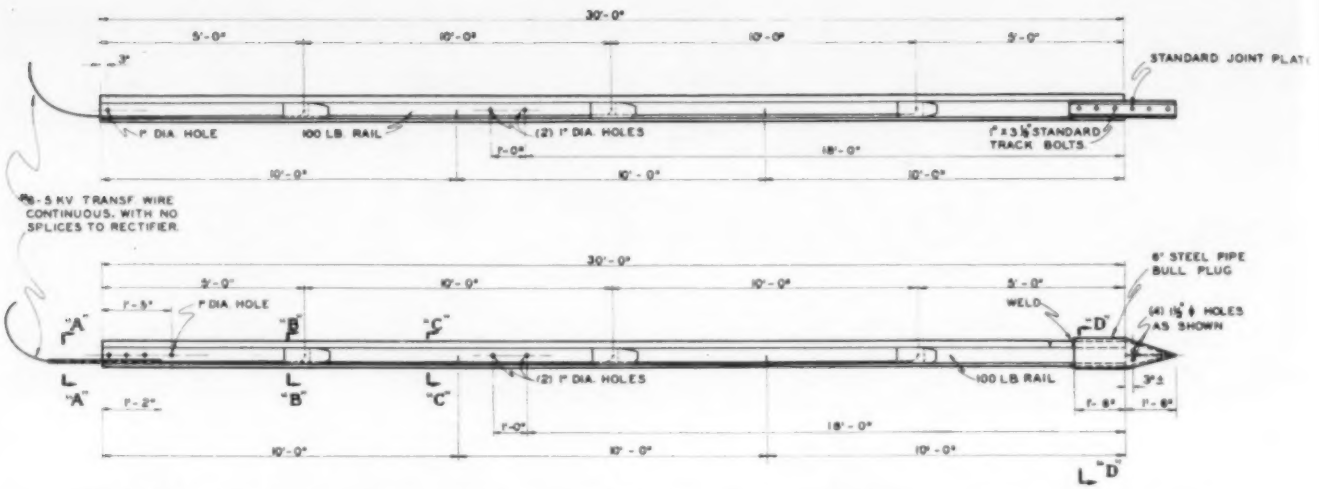


FIGURE 3—Deep rail ground bed. Rails are joined with plate; individual lead wires run from each joint to surface.

are lowered into the hole by means of a ¼ inch diameter wire rope. The rails are joined longitudinally by joint plates, and a separate wire with no splices is brought from each rail length to the surface of the earth. The resistance to earth of this type of ground bed is in the general order of 0.2 ohm, excluding lead wire resistance. The installation is designed for five-ampere current discharge and its estimated life is 10 years, figuring only half of the 2000 pound weight of iron would be consumed by the current discharge and the balance lost by segregation.

Rails were used because of the availability of a fairly large surplus of used rails, salvaged from discontinued street car lines. Various other materials, such as graphite or high silicon cast iron, could be used instead of rails for the anode. The cost of such a ground bed installed is approximately $750. In congested areas the $750 figure works out to be cheaper than the $250 for a conventional shallow ground bed because of the elimination of expense of trial ground beds and joint testing with other utilities.

3. Deep stalk rail ground bed (Figure 4). This type of ground bed consists of 12—30 foot lengths of 100 lb/yd used Tee rail inserted vertically into a drilled hole 360 ft. deep. The top of the uppermost rail practically flush with the ground. The cost of

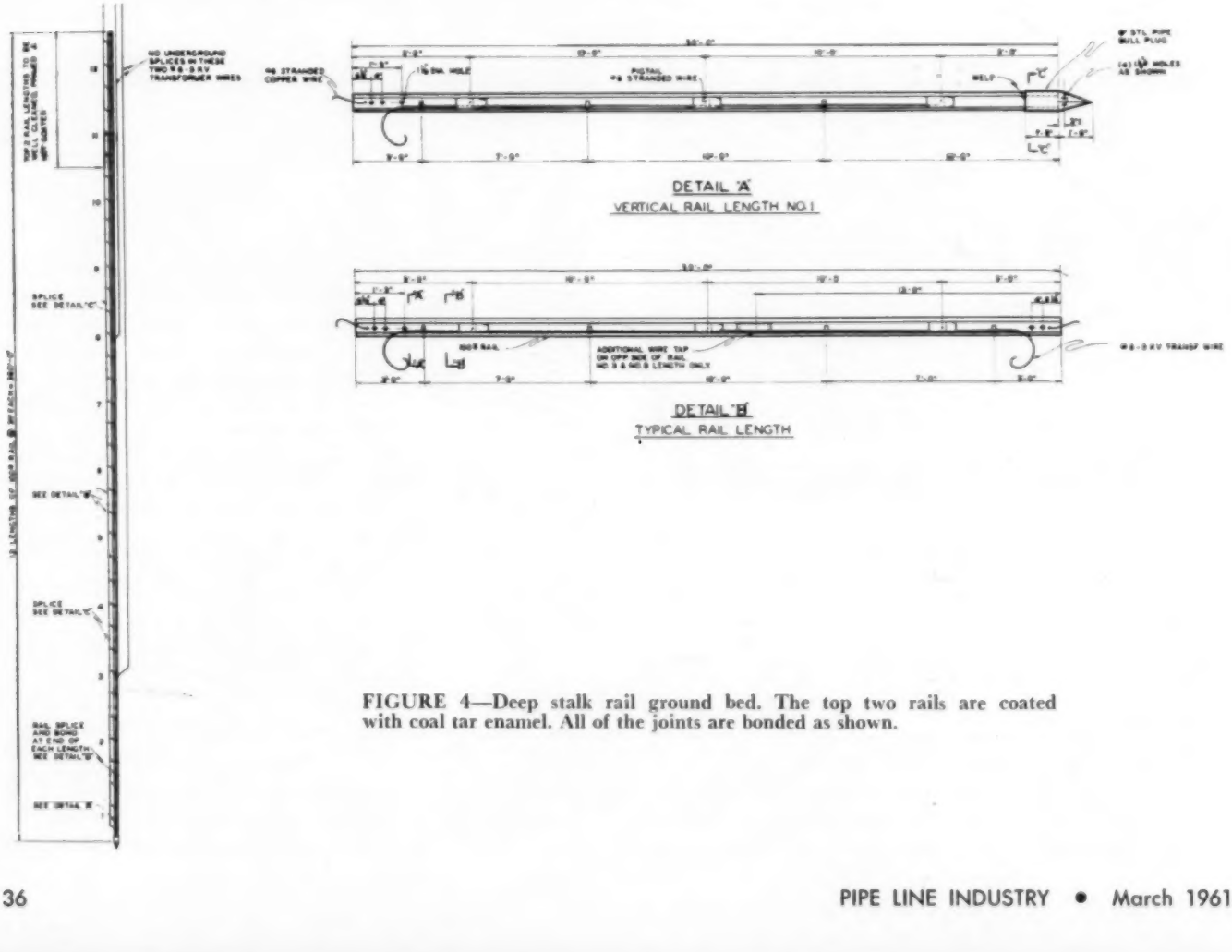

DETAIL "A"
VERTICAL RAIL LENGTH NO. 1
DETAIL "B"
TYPICAL RAIL LENGTH
SPLICE SEE DETAIL "C"
SEE DETAIL "B"
SPLICE SEE DETAIL "C"
RAIL SPLICE AND BOND AT END OF EACH LENGTH SEE DETAIL "B"
SEE DETAIL "A"

FIGURE 4—Deep stalk rail ground bed. The top two rails are coated with coal tar enamel. All of the joints are bonded as shown.

such a bed, designed for 10-year life at 30 amperes current discharge would be approximately $1,750 installed. This type of ground bed has an extremely low resistance to earth, in the order of 0.05 ohms.

Calculating Ground Bed Resistance. The resistance of a metal hemisphere buried at the earth's surface, flat side up, to any shell of earth concentric to the hemisphere is given by the expression:

$$(1)\quad R_r = \frac{\rho}{2\pi}\int_{r_1}^{r}\frac{dr}{r^2} = \frac{\varepsilon}{2\pi}\left(\frac{1}{r_1} - \frac{1}{r}\right)$$

The resistance of a metal sphere buried deep in the earth to any shell of earth concentric to the sphere is given by the expression:

$$(2)\quad R_r = \frac{\rho}{4\pi}\int_{r_1}^{r}\frac{dr}{r^2} = \frac{\rho}{4\pi}\left(\frac{1}{r_1} - \frac{1}{r}\right)$$

In formulas (1) and (2):

R_r = resistance of the earth in ohms at a distance r from center of hemisphere (or sphere) measured in centimeters.

ε = uniform soil resistivity in ohm centimeters.

r_1 = radius in centimeters of hemisphere (or sphere).

r = distance in centimeters from center of hemisphere (or sphere) to which resistance to earth is to be computed.

Comparison of the above formulae shows the resistance of a deep spherical ground bed to a distance "r" cm from the center of the sphere is only half that of a hemispherical ground bed buried at the earth's surface, the resistivity of the soil being the same.

Included in Table 1 for comparative purposes is a tabulation of the resistance of a hemisphere 15 cm radius, or roughly one-foot diameter to earth at various distances from the center of the hemisphere, and corresponding voltage drops caused by the discharge of 10 amperes from the hemisphere. The second part of the tabulation shows corresponding calculated resistances and voltage drops for 10 ampere discharge from a deep spherical ground bed, the soil resistivity in each case being, for sake of simplicity in calculations, 628 ohms-em, which value is commonly encountered in the New Orleans area. Because of the larger volume of soil involved, the values of resistance and voltage drops for the deep sphere are only half those of the shallow hemisphere. At 250—300 feet the clay is wet, being always well below the natural water table. This is not intended to imply that a shallow horizontal ground bed such as shown in Figure 2 is, in the strictest sense, a hemispherical ground bed, or that the deep vertical ground bed shown in Figure 3 is a spherical ground bed, but, in the final analysis, each may be though of as approaching these respecatik2 rforhtgroundt ing these respective hypothetical types of ground beds insofar as the IR drops near the surface of the earth caused by current discharge from them is concerned.

Within approximately 100 feet of earth which would be appreciably influenced by the shallow horizontal ground bed, this type of ground bed would have only a hemisphere of earth 100 feet in radius in which to dissipate its current discharge. But the deep vertical bed would have a sphere of earth, of the same radius, in which to dissipate, hence IR drops near the surface of

TABLE 1—Voltage Values in Earth Surrounding a Hemispherical Ground Bed at Earth Surface, and a Deep Spherical Ground Bed, each Discharging 10 Amperes

ρ = 628 ohm. cm. Radius of hemisphere and sphere 15 cm. (r_1)

DISTANCE FROM CENTER OF HEMISPHERE OR SPHERE (r)		HEMISPHERE		SPHERE	
		Resistance in ohms (R_r)	Voltage drop from center, volts	Resistance in ohms (R_r)	Voltage drop from center, volts
15 cm		0.42	4.2	0.21	2.10
20		1.67	16.7	0.885	8.85
30	0.98 ft.	3.33	33.3	1.665	16.65
60		5.00	50.0	2.5	25.0
90		5.56	55.6	2.78	27.8
120		5.83	58.3	2.965	29.65
150		6.00	60.0	3.000	30.0
180		6.11	61.1	3.055	30.55
210		6.19	61.9	3.095	30.95
300	9.84	6.33	63.3	3.165	31.65
3000	98.4	6.63	66.3	3.315	33.15
30000	984.	6.663	66.63	3.3315	33.315
300000		6.666	66.66	3.333	33.33
3000000		6.6666	66666	3.33333	33.3333

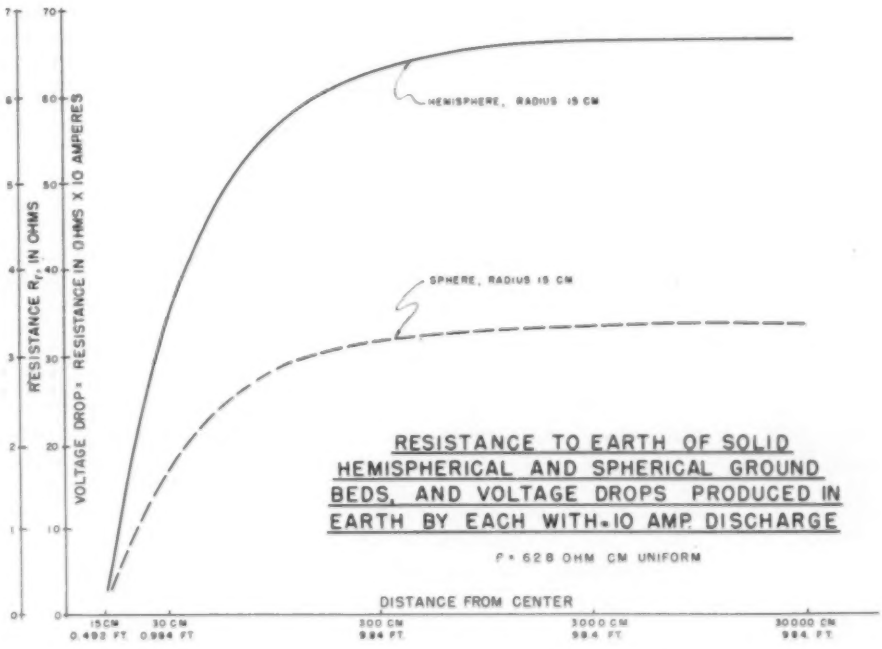

RESISTANCE R_r IN OHMS
VOLTAGE DROP = RESISTANCE IN OHMS X 10 AMPERES
HEMISPHERE, RADIUS 15 CM
SPHERE, RADIUS 15 CM
RESISTANCE TO EARTH OF SOLID HEMISPHERICAL AND SPHERICAL GROUND BEDS, AND VOLTAGE DROPS PRODUCED IN EARTH BY EACH WITH 10 AMP DISCHARGE
ρ = 628 OHM CM UNIFORM
DISTANCE FROM CENTER
15 CM 0.492 FT.
30 CM 0.984 FT.
300 CM 9.84 FT.
3000 CM 98.4 FT.
30000 CM 984. FT.

FIGURE 5—Resistance and voltage drop plotted on semi-log paper.

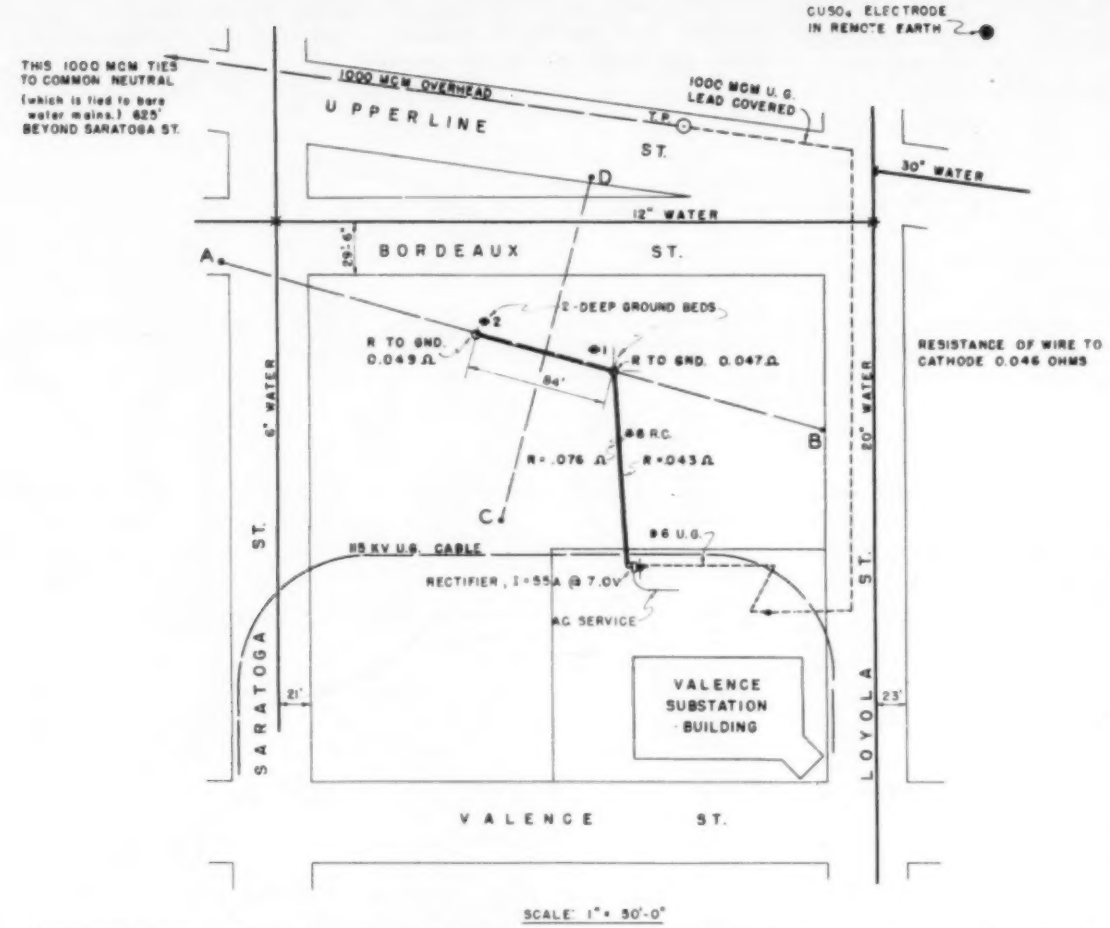


FIGURE 6—Two deep stalk rail ground beds shown at No. 1 and No. 2. The negative side of rectifier is tied to common neutral system which is bonded to bare cast iron water pipe system over 1,000 feet away.

the earth caused by current discharge from the shallow ground bed would be substantially higher than the IR drops near the surface of the earth caused by the same amount of current discharging from the deep vertical ground bed. For all practical purposes, the same net effect could be secured by locating the shallow bed, the same distance laterally from the foreign structures as the deep ground bed is separated from the foreign structures vertically, but in a city crowded with networks of foreign structures, it is virtually impossible to secure the desired clearances laterally which can easily be attained vertically by use of the deep ground bed.

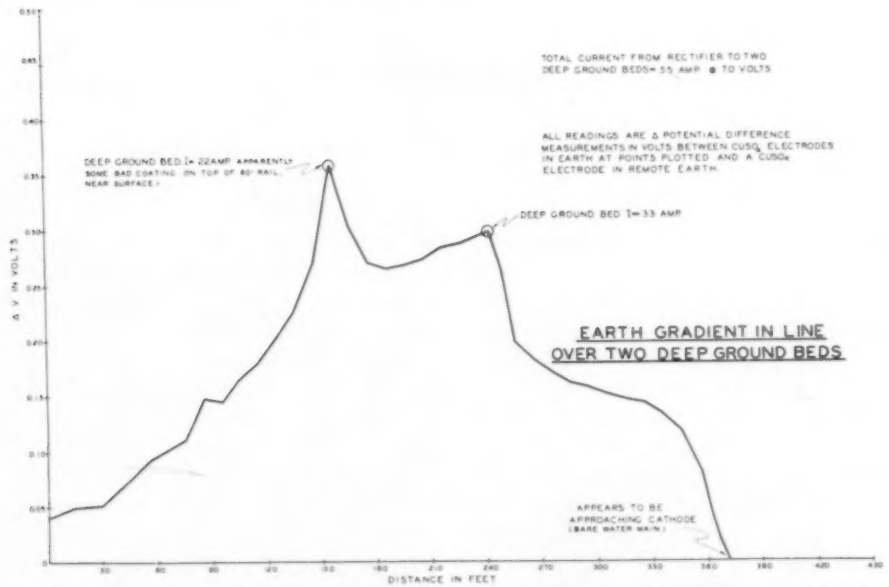

TOTAL CURRENT FROM RECTIFIER TO TWO DEEP GROUND BEDS= 55 AMP. @ 70 VOLTS
ALL READINGS ARE Δ POTENTIAL DIFFERENCE MEASUREMENTS IN VOLTS BETWEEN CUSO4 ELECTRODES IN EARTH AT POINTS PLOTTED AND A CUSO4 ELECTRODE IN REMOTE EARTH
DEEP GROUND BED I= 22AMP. APPARENTLY SOME BAD COATING ON TOP OF 60' RAIL NEAR SURFACE.)
DEEP GROUND BED I=33 AMP.
EARTH GRADIENT IN LINE OVER TWO DEEP GROUND BEDS
APPEARS TO BE APPROACHING CATHODE (BARE WATER MAIN)
Δ V IN VOLTS
DISTANCE IN FEET

FIGURE 7—Profile of change of earth potential along line AB in Figure 6. Each point plotted is change of potential between rectifier off and rectifier on readings of a $CuSO_4$ electrode placed at each point plotted and a remote $CuSO_4$ electrode.

In Figure 5 resistance and voltage drop data from the above tabulations are plotted on semi-log paper, predicated upon the same soil resistivity at great depth as that encountered at shallow depths. Note that the steepest part of the lower curve would be at points in the earth 250 feet to 300 feet below the earth's surface and, therefore, 250 feet to 300 feet from the closest foreign lines. Thus the advantage of the deep ground bed in the solution of the most troublesome part of the cathodic protection coordination problem should be readily obvious.

Figure 6 shows the location of two deep stalk rail ground beds at a large electric substation. For purposes of gathering field data to demonstrate earth effects to be shown in two sub-

quent figures, the rectifier was temporarily set at 55A, 7.0 volts. The negative side of the rectifier was tied to the common neutral system which is bonded solidly to the bare cast iron water pipe system over 1,000 feet away. A profile of change of earth potentials referred to a remote $CuSO_4$ electrode was measured at 10-foot intervals along line AB, and also along line CD which is normal to the first line. Note the position of the bare cast iron water mains on this sketch, for, as will be shown on the subsequent two figures, the collection of current on these bare mains, even though the drainage point is more than 1,000 feet away, causes noticeable earth gradients towards the water mains.

Figure 7 shows a profile of change of earth potential across line AB. Each point plotted is the change of potential between rectifier off and rectifier on readings of a $CuSO_4$ electrode placed at each point plotted and a remote $CuSO_4$ electrode. One ground bed was discharging 22 amperes and the other 33 amperes, at 7.0 volts. Note that the change of earth potential is higher at the ground bed discharging 22 amps. The top 60 feet of each of these particular rail ground beds is coated, but apparently there must have been a bare spot on the coating of the one discharging 22 amperes which is causing the relatively high peak shown. Actually, however, the values are quite small, but are plotted on a large scale. A total of 55 amperes is being introduced into the earth here and the highest point of earth rise is only about 0.35 volts right at the ground bed. Within 100 feet this drops to less than 0.1 volt. Note the sharp drop in the earth potential at the right hand side of the curve, as the bare water main is approached. On the left hand end of the curve, another water main is crossed but practically no effect is shown. This indicates high resistance caulked joints in the water main system, such that this main is not tied in too solidly to the balance of the water main system.

Figure 8 shows another profile along a line CD which is normal to the first line, and midway between the two rail stalks. This line passes 42 feet from each ground bed, and the highest rise of earth potential is 0.27 volts with 55 ampere discharge. Note also the dip in the earth potential at the 180-foot mark. This is right over the 12-inch bare cast iron water main which is electrically drained about 1,000 feet away.

Table 2 shows the resistance to earth of various deep or vertical rail stalk ground beds in the New Orleans Public Service, Inc., system.

The 360-foot stalks as mentioned before are very low in resistance, being approximately 0.05 ohms, as shown. The balance of the installations listed include lead wire resistance which should be subtracted from the values shown in order to obtain the true resistance of the ground bed to earth. For instance, if the resistance of the No. 8 lead wire were subtracted for the installation at Roman near Tulane, which consists of 2 30-foot lengths of rails, 250 foot depth, the true resistance to earth would be 0.17 ohm. Two rails side by side buried horizontally 9 feet deep would be 0.5 ohm, so it can be seen that in the New Orleans area extremely low resistance to earth can be secured when the rails are located deep.

Figure 9 is probably the most striking. It combines a number of changes of earth potential caused by 10 ampere discharge from a shallow bed and later from a deep rail ground bed, the ground beds not being energized simultaneously. Change of potential difference readings between a $CuSO_4$ electrode at various intervals and a remote

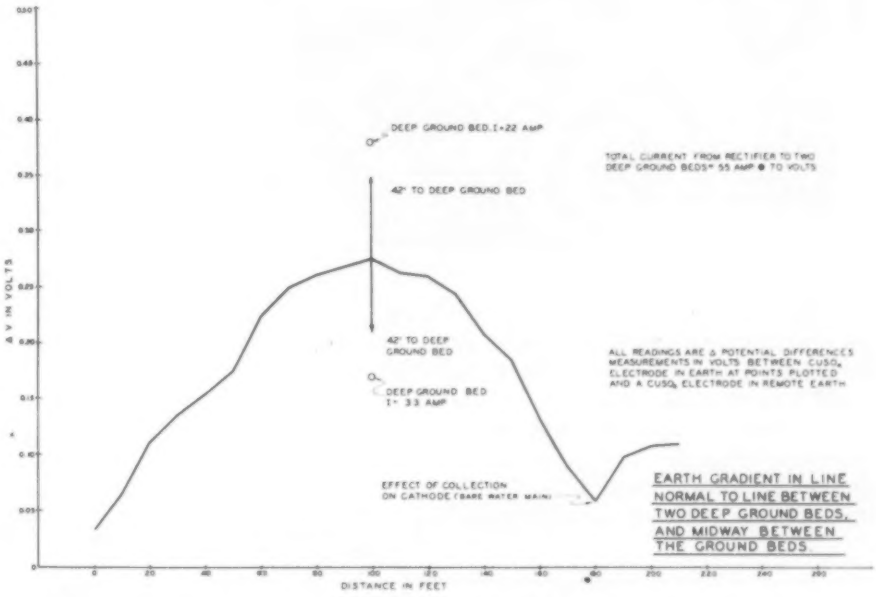

DEEP GROUND BED, I=22 AMP
TOTAL CURRENT FROM RECTIFIER TO TWO DEEP GROUND BEDS= 55 AMP. 7 VOLTS
42' TO DEEP GROUND BED
42' TO DEEP GROUND BED
DEEP GROUND BED I= 33 AMP
ALL READINGS ARE Δ POTENTIAL DIFFERENCES MEASUREMENTS IN VOLTS BETWEEN CuSO4 ELECTRODE IN EARTH AT POINTS PLOTTED AND A CuSO4 ELECTRODE IN REMOTE EARTH
EFFECT OF COLLECTION ON CATHODE (BARE WATER MAIN)
EARTH GRADIENT IN LINE NORMAL TO LINE BETWEEN TWO DEEP GROUND BEDS, AND MIDWAY BETWEEN THE GROUND BEDS
Δ V IN VOLTS
DISTANCE IN FEET

FIGURE 8—Profile along line CD in Figure 6. This line passes 42 feet from each ground bed.

TABLE 2—Resistance to Earth of Various Deep Rail Ground Beds

LOCATION & DATE INSTALLED	DESCRIPTION	RESISTANCE TO EARTH
Valence Sub. (#1) " " (#2) (4-13-54)	360' of 100 #/yd. tee rail, top flush with ground. Top 60' coated " " " " " " " " " " " "	0.047 ohms 0.049
Gen. Pershing near Rendon (12-18-53)	2-30' lengths 100#/yd. tee rail. Bottom 250' deep	0.217 *
Roman near Tulane (12-21-52)	2-30' lengths 100#/yd. tee rail. Bottom 250' deep	0.251 *
Canal Blvd. near R. E. Lee (12-22-52)	2-30' lengths 100#/yd. tee rail. Bottom 250' deep	0.233 *
Bienville Plaza (#1) " " (#2) " " (#3) Combination of 1, 2, 3 (9-10-54)	4-30' lengths 100#/yd. tee rail. Bottom 390' deep " 	0.334 * 0.364 * 0.251 * 0.110 *
Washington Square (5-24-54)	360' of 100#/yd. tee rail, top flush with ground, all bare	0.055

* Includes resistance of #6 (or #8 wire) from rectifier to rails (R/1000' #6= 394 ohms, #8= 627 ohms)

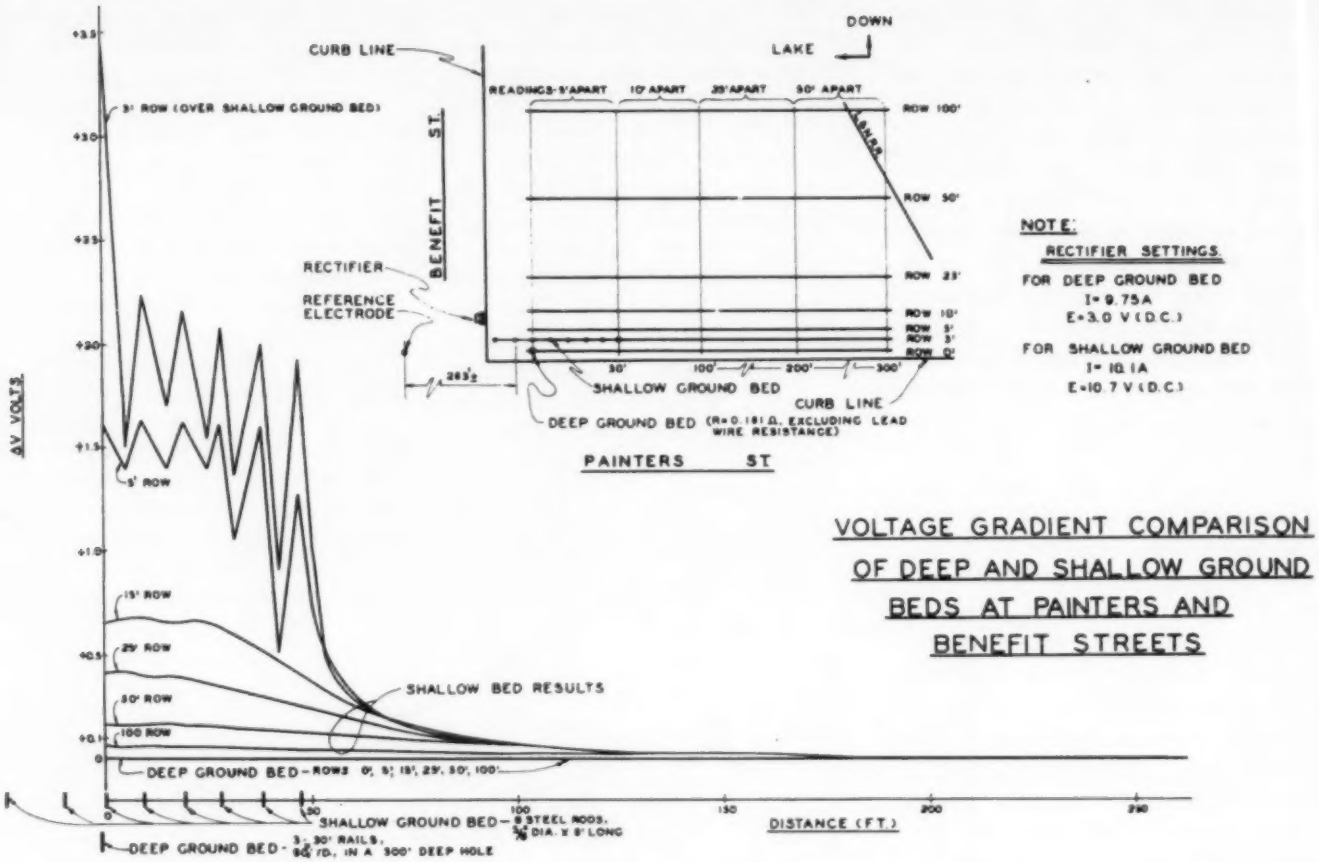


FIGURE 9—Changes in potential caused by 10 amp discharge from shallow bed and later from a deep rail.

$CuSO_4$ electrode were measured in a line directly over the shallow bed, and in rows 2, 7, 22, 47 and 97 feet away from and paralleling the shallow ground bed. Another set of readings was made directly over a deep rail ground bed and in rows 5, 10, 25, 50 and 100 feet away from the deep rail ground bed. The results of these tests were plotted as shown, and demonstrate that even for 10 amperes discharge in 500 ohm/cm soil, appreciably steep earth gradients are encountered for the shallow bed, whereas for the deep bed, the curve is flat.

About the Authors

Trouard Wagner, Jr.

Sidney E. Trouard was graduated from the University of Dayton (Ohio) in 1928 with a B.S. in electrical engineering and immediately joined his present company, the New Orleans Public Service Inc. to specialize in corrosion mitigation work. He is past chairman for two terms (1948-50) of the AGA Corrosion Committee. In 1957 he received the AGA Distribution Achievement Award. He is a member of AGA, AIEE, NACE and the Louisiana Engineering Society. He is a registered professional engineer.

E. A. Wagner, Jr. is assistant engineer in corrosion mitigation work with New Orleans Public Service Inc. He was graduated in electrical engineering from Louisiana State University in 1944 and joined the Army Ordnance Dept. From 1946 to 1951 he taught mathematics and electricity at Delgado Trades School in New Orleans. He joined his present company in 1951. Wagner is a member of AIEE and a registered professional engineer in Louisiana.

Conclusions. The advantages of deep ground beds may be briefly summarized as follows:

1. Full rectifier capacity is available for protection of structure to be cathodically protected. No current need be drained from foreign lines because of direct pickup effect. This means elimination of distributed drainage system for foreign lines, with consequent savings.

2. Lower power costs because of drastically reduced ground bed to earth resistance.

3. Smaller space required for deep ground bed.

4. Deep ground bed can be installed at any convenient location. No right of way problems are involved.

5. Cost of cathodic protection coordination tests is practically eliminated since current pickup on foreign lines is negligible.

6. No time lost in surveys to find suitable locations for conventional shallow ground beds.

ACKNOWLEDGMENT

Prom a paper presented at the American Gas Association Distribution-Transmission Conference 1960, New Orleans.

Columbia Gulf required critical inspection of 24-inch pipe for its dual crossing of Mississippi near Mayersville. Magnetic particle external surface inspection, internal visual inspection and ultrasonic test for wall thickness were applied before pipe was coated. Left, during external surface check powder is dusted on pipe as direct current is applied through magnetic contact. Where laps or other discontinuities were discovered, an electrical grinder, right, was used to grind them out. Then surface crack was checked for depth with micrometer. If it exceeded 0.060-inch, that segment of pipe was cut out.

River Crossing Pipe Passes Tough Inspection

Columbia Gulf applied ultrasonic test, magnetic particle external surface inspection and visual internal surface check on 24-inch pipe for dual Mississippi River crossing

By Donald G. De Pugh

Construction Editor

PIPELINE INDUSTRY

THE IDEAL BURIED Mississippi River crossing is a pipe line that never leaks, is laid deep enough to prevent exposure even from the scouring river and, in short, just lies there and becomes a forgotten line. To achieve this "perfect crossing," Columbia Gulf Transmission Company's engineers recently introduced several advances in river crossing pipe design.

To place its dual 24-inch gas line across the one-mile-wide Mississippi at a point near Mayersville, Miss., a huge trench was cut under the river—90-feet wide and 40-feet deep—extending deep cuts into the unstable banks nearly 900 feet on both sides.

A leak under the Mississippi could be very costly and difficult to find and repair. Therefore, Columbia Gulf tried to lay two near-perfect one-mile lines.

To do this, engineers decided to give the pipe a complete inspection

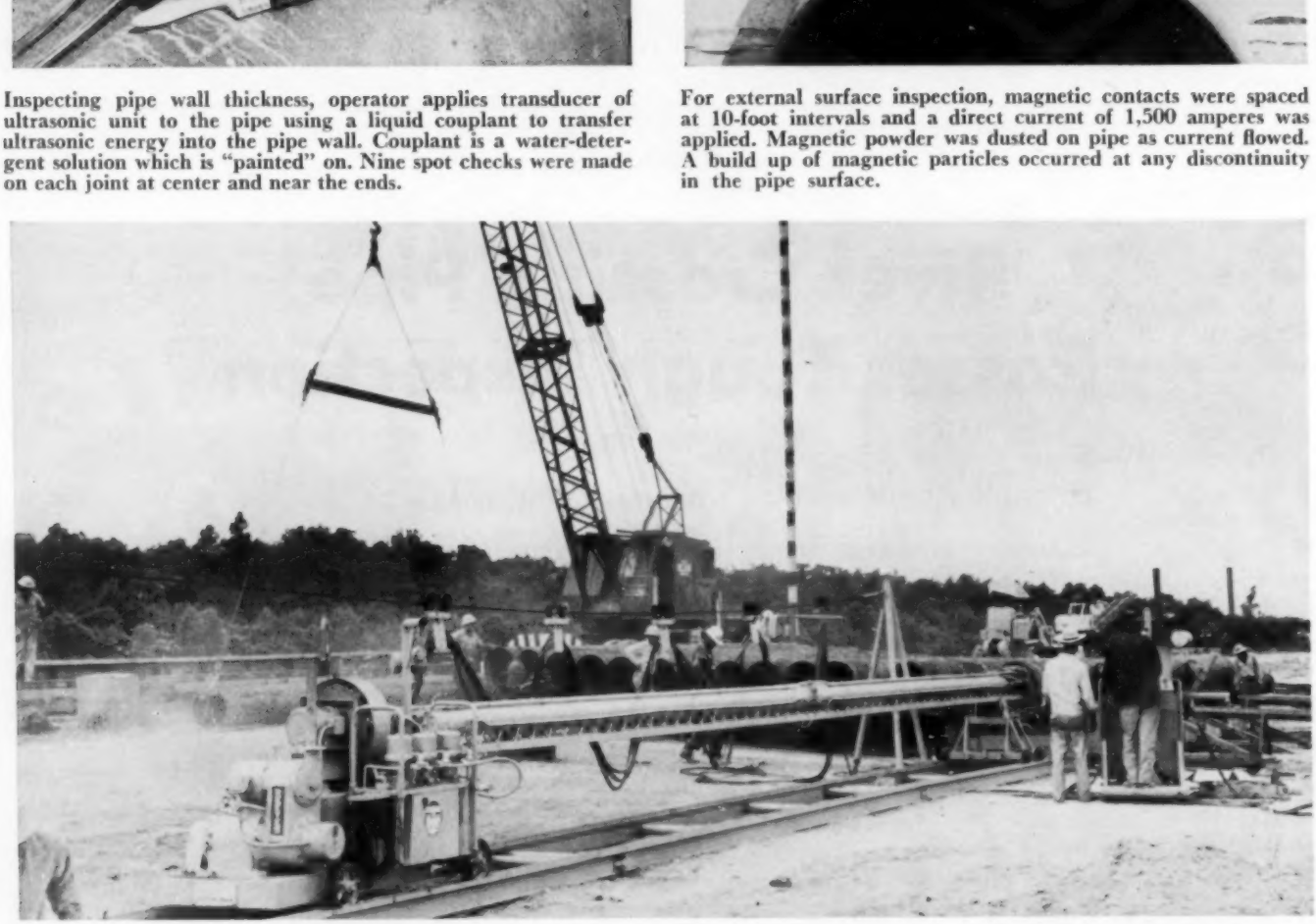
for any wall thickness inaccuracies and for any external or internal surface discontinuities. This severe inspection was carried out at H. C. Price's Harvey, La., yard after the pipe had been internally coated. Following inspection, Price applied asphalt-mastic and concrete coating.

THREE-WAY INSPECTION

Pipe for the crossing was 24-inch, API 5LX 42 seamless with a wall thickness of 0.500-inch. Columbia

Inspecting pipe wall thickness, operator applies transducer of ultrasonic unit to the pipe using a liquid couplant to transfer ultrasonic energy into the pipe wall. Couplant is a water-detergent solution which is "painted" on. Nine spot checks were made on each joint at center and near the ends.

For external surface inspection, magnetic contacts were spaced at 10-foot intervals and a direct current of 1,500 amperes was applied. Magnetic powder was dusted on pipe as current flowed. A build up of magnetic particles occurred at any discontinuity in the pipe surface.



An internal coating machine applied 1½-2-mil dry film epoxy on each joint. The machine cleans pipe in one pass. As boom is retracted it cleans pipe again and the spray head on head of boom applies coating.

Gulf's ultrasonic inspection specifications called for a minimum wall thickness of 0.440 inch. An ultrasonic testing unit applied nine spot checks on each joint to determine thickness. Sets of three readings were taken at the center of the pipe and about 10 feet from each end of the joint; at each location the three measurements were spaced 120 degrees apart around the pipe circumference.

Wall Thickness Test. The ultrasonic testing unit, using a lithium sulphate transducer, sends an ultrasonic wave through the pipe wall which is reflected back to give exact wall thickness. Also, any laminations perpendicular to the plane of the transducer will be detected because they interfere with the ultrasonic waves and the wall thickness indication will be only to the lamination point. Other discontinuities such as segregation inclusions or porosity will absorb the wave and yield no reflection.

The transducer signal is applied to the pipe through a liquid couplant which transfers ultrasonic wave energy to the wall. Couplant in this case was a water and detergent solution applied with a paint brush.

Since any thin wall or discontinuity in the pipe would be a point of stress under operating pressure, specifications called for these sections to be cut out of the joint. The operator inspected each joint and marked the areas to be cut. After all three inspections were completed, these sections of pipe containing the rejected areas were cut out of the imperfect joints, and the pup-joints were re-welded. Joints were then coated and sent to the job site.

After receiving critical inspection, pipe was coated with a 3/8-inch asphalt-mastic coating and a 2 1/16-inch application of 190-pound concrete coating.

As a result of the ultrasonic test on 360 joints, eight sections—ranging from 18 inches up to 7 feet in length—were rejected. Thickness on these segments ranged from 0.425 inch to 0.440 inch; there was never more than one section per joint. Most sections were in the center of the joints.

External Surface Check. The second critical test the pipe underwent was a magnetic particle external surface inspection. Circular magnetization was used with a minimum direct current of 1,500 amperes applied through magnetic attachment contacts—leeches. Contact spacing called for four leeches per joint at 10-foot intervals placed in about 45 degree angles; pipe was then rolled 180 degrees and the process repeated to inspect the entire joint.

Two operators worked from opposite ends of the pipe toward the center in applying the magnetic test. Contacts were set on the pipe at 10-foot intervals and a fine magnetic powder was sprayed on the pipe as current was flowing. Any cracks, laminations or other discontinuities were easily spotted as the powder was applied. At these points a build up of magnetic particles occurred and they were visible to the naked eye. Direct current was used because it penetrates steel deeper and also can detect possible sub-surface cracks. Any discontinuities either in the direction of the current or perpendicular to the magnetic field around the current were detected.

Where discontinuities were found they were ground out with an electric grinder. Depressions were then measured; if the depth was greater than 0.060 inch that section was marked as a reject. Through this inspection 13 bad spots were discovered and rejected. These segments ranged from 3 inches to 20 inches long at various locations on the joints and again there

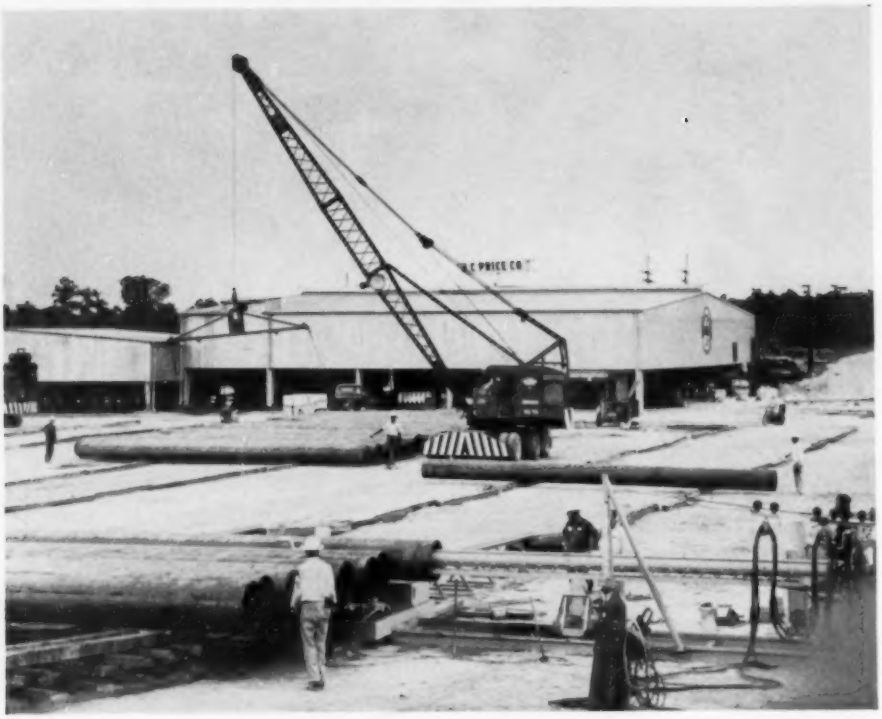
Results of Wall Thickness, External and Internal Surface Tests

. . These are results of Columbia Gulf's ultrasonic test for wall thickness, magnetic particle external surface and visual internal surface inspection on approximately 13,000 feet of 24-inch, 0.500-inch wall thickness river crossing pipe:

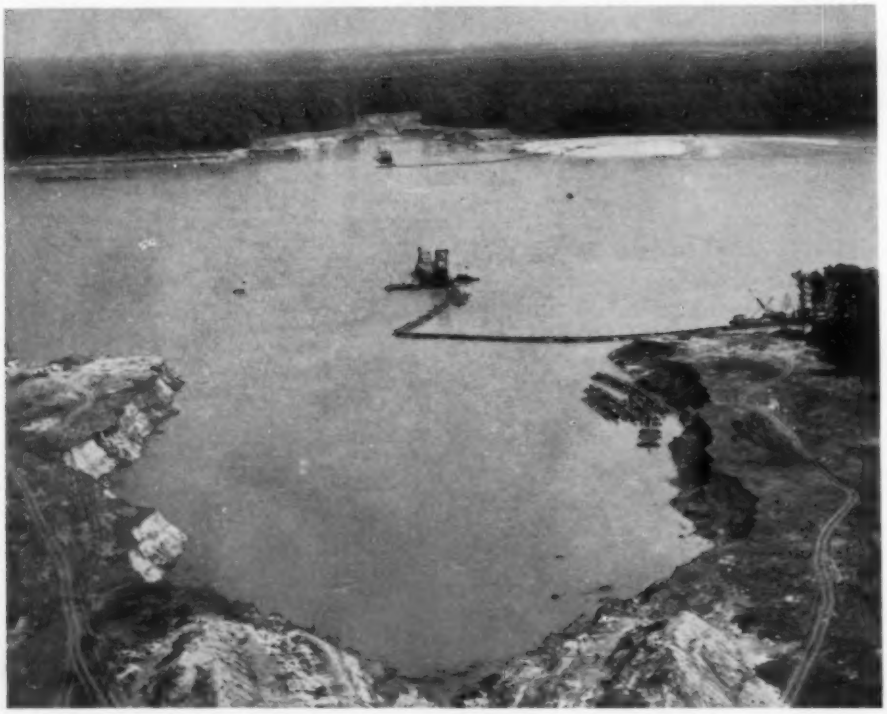
1. Wall Thickness Inspection (Ultrasonic). Eight sections, from 18 inches to seven feet in length, were rejected because wall was less than 0.440-inch.

2. External Surface Inspection (Magnetic Particle). Thirteen segments, from 3 inches to 20 inches in length, were rejected because of discontinuities.

3. Internal Surface Inspection (Coated-Visual). Nine segments, from 3 inches to 12 inches in length, were rejected because of discontinuities.



Overall view of internal coating and ispection layout at H. C. Price Company's Harvey, La., yard.



Contractor J. Ray McDermott excavated 4.1 million cubic yards of mud and silt from the one-mile trench across the Mississippi. Deep cuts also were made 900-feet into the banks and the 30-inch approach line was concrete coated for the marshy area.

was never more than one section in any given joint.

Internal Surface Inspection. The third inspection method was a visual inspection of the internal surface. This was done after the pipe had been internally coated and the inspection was accomplished using a mercury vapor light focused on the slick inside surface from both ends of the joint. While inspecting from one end, the opposite end was closed. With the aid of glossy epoxy coating and bright vapor light, any laps were spotted readily. When a discontinuity was located, a man was sent inside the pipe to grind it out and measure the depth of the crack. If it exceeded 0.060 inch that section was marked for rejection. There were nine segments that had to be rejected on the internal surface check. These ranged from 3 inches to 12 inches in length. As in the other tests, never more than one rejected segment appeared in a single joint. Also, there were no duplications of joints with weak spots among the three different tests.

Coating Methods. For protection against any possible internal corrosion, the pipe was internally coated. Specifications called for a 1½-2-mil dry film epoxy coating.

The rotating dual-purpose head of the coating machine was pushed through the joint by an electrically operated boom. It cleaned the pipe on the first pass and applied the coating as it was retracted.

After the pipe wall was thoroughly inspected, H. C. Price applied a ⅜-inch asphalt-mastic coating and a 2¹⁄₁₆-inch coat of concrete on the river pipe. With the asphalt-mastic and 190-pound density concrete coating, each 40-foot joint, weighed 15,386 pounds. This produced a specific gravity of 1.36 in fresh water. To check the specific gravity of finished pipe, each joint was weighed and the outside diameter measured with a tree tape.

Construction. In laying the 30-inch, X-56 main line up to the Mississippi, Columbia Gulf used 6,928 feet of 0.375-inch wall thickness pipe outside the levees. Inside the levees, 14,472 feet of 0.469-inch wall pipe was used. About 7,700 feet of the 30-inch received an asphalt-mastic coating and 13,204 feet was concrete coated as well, to meet a 1.15 specific gravity.

The treacherous Mississippi has scoured 29 river crossings and its swift currents are presently taking their action on Columbia's existing crossing near Mayersville which was installed in 1953. The river has been cutting into the east bank and exposing the two 16-inch and two 24-inch lines. Columbia had to lower a section of this crossing in 1958 to prevent it from being undercut.

Contractor J. Ray McDermott dredged the 90 by 40-foot trench by excavating some 4.1 million cubic yards of mud and silt. Both lines were laid in the same trench. Columbia Gulf tested the 30-inch land line hydrostatically to 1,350 psi and the 24-inch underwater lines were tested to 1,260 psi. —The End

Laboratory Studies of Asphalt Coatings

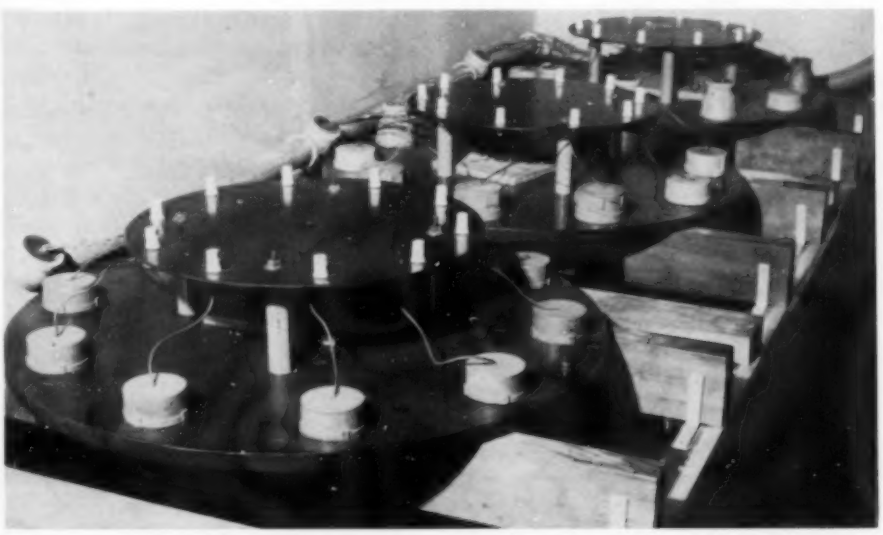
Conductivity test. Asphalt coating sample after 16 months of testing. Coating has been peeled back with knife to determine whether or not disbonding took place. None was apparent.

Differences in environments can make specific characteristics of coatings of greater or lesser importance. Many of these factors show up in laboratory tests

By Pearce R. Butterfield
Consulting Corrosion Engineer
Houston, Texas

IN DETERMINING the acceptability of a material for use as an underground pipe line coating, the following characteristics should be considered:

1. Cost compared with other available and acceptable coatings
2. Resistance to moisture vapor transmission
3. Ability to bond to coated surface
4. Resistance to disbonding as a result of cathodic protection
5. Resistance to cold flow
6. Resistance to penetration
7. Flexibility
8. Ease of application
9. Resistance to deformation by soil stress
10. Resistance to solubility in the expected environment
11. Dielectric strength



Conductivity disbonding tests. Holidays, 1/16-inch were drilled in holiday-free coatings. Then potentials above the hydrogen over-voltage for steel were applied and the amount of disbonding was measured.

This list is not intended to be in order of decreasing importance, as any one of these characteristics could be of extreme importance on a pipe line located in one area and of minimum importance in another area. For example, the resistance of a coating to deformation by soil stress could be of small importance if the line were located in a marine area where the coating would be constantly submerged in water or in a completely saturated environment. However, if the line is to be located in an area where the soil exhibits a high degree of soil stress, the resistance of the coating to these stresses would be of major importance.

The quality of the coating as represented by the area of the bare pipe in contact with the earth is dependent on many factors other than the characteristics of the material used as a coating. The initial unit coating resistance and current requirements for cathodic protection are more dependent on the coating application technique and pipe line construction practices than on the actual characteristics of the coating material used. Once the line is in service, the ability of the coating to resist the deleterious effects of the environment becomes very important. However, some substandard construction factors may contrib-

ute to a poor performance of the coating after the line is in service. These factors could include *improper pipe cleaning, thin coating, wrong placement of pipe wraps if used, and incorrect heating of the coating before application.*

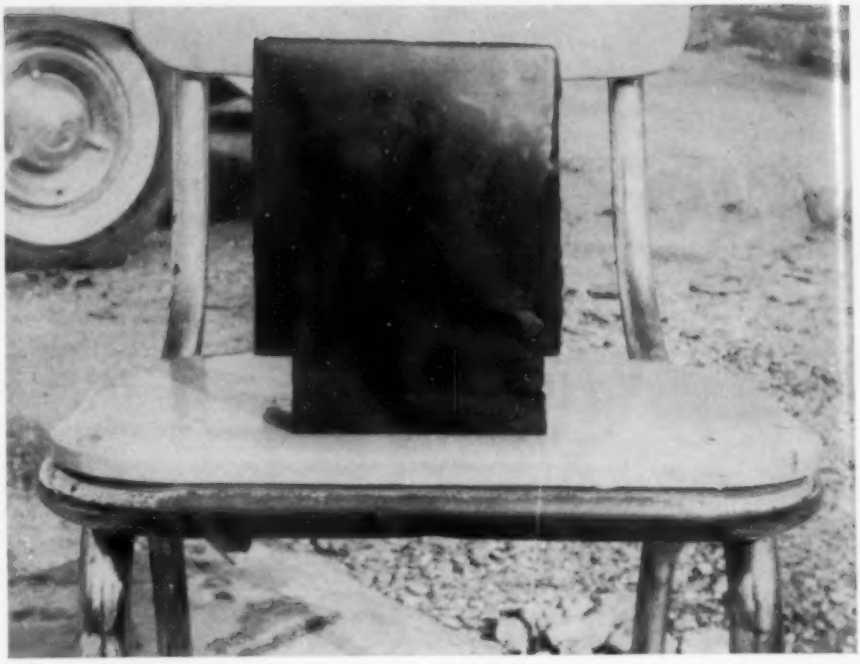
Factors which may contribute to the initial quality of the coating as represented by unit coating resistance or current requirement for cathodic protection upon completion of the line are:

1. Integrity of the contractor
2. Temperament of the coating crew at any specific time
3. Degree and ability of company inspection
4. Condition of the pipe surface
5. Type of coating application used (yard or over-the-ditch).
6. Moisture and temperature conditions at time of coating application
7. Type of terrain
8. Type of soil

While these factors are basic and well known to corrosion engineers, they are sometimes overlooked in the press of high-speed construction. For example, in rugged terrain too much attention may be given to the primary task of laying the line, forgetting that the rough handling can result in additional gouges and scratches in the coating. Too, extreme slopes make it difficult to apply a uniform coating, and hard clods of dirt in the bottom of the ditch can cause holidays unless removed.

Laboratory Tests of Asphalt Coatings. This discussion is based on research sponsored by the Gulf States Asphalt Company, Inc. One portion of the project is the comparison of various materials according to certain tests conducted in the laboratory. The second part of the project is the conductance of coating resistance and current requirement tests on asphalt coated lines located in various sections of the country that have been in service for 4 to 17 years.

Laboratory tests were designed to test in an accelerated manner, various important characteristics which would be required for a material to be used as a pipe line coating. Perhaps no laboratory test may be designed which would precisely fit the conditions found on an operating pipe line. However, if all materials are tested under the same controlled conditions, the results should be a valid comparison of the materials and at the very least should indicate how the coatings should perform on a buried line.



High temperature test. Steel plates were coated, then held in horizontal plane at 160°F for 24 hours; then the sag was measured.

All coated specimens used in the laboratory testing program were prepared by the same laboratory techniques. The results have been substantiated by simultaneously conducting tests on duplicate specimens and appear to correlate very well with the results of similar tests which have been conducted by operating companies.

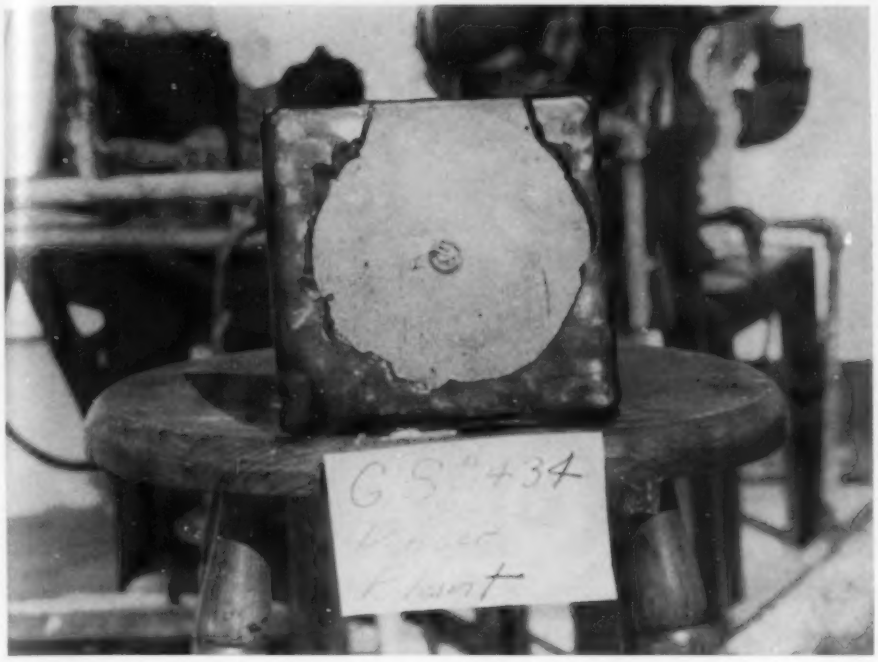
Following is a description of the laboratory tests which have been conducted and the results obtained:

Conductivity Test

Purpose of Test — To evaluate the resistance of a coating to the conductance of cathodic protection current.

Description of Test—2 x 30-inch pipe nipples were used as test specimens. The primer and enamel were applied according to the coating manufacturer's recommendations and good coating practices. The coating was specified to be 94 mils (± 5 mils) (1 mil = 0.001 inches). No reinforcement or wrap was included in the coating system. The lower ends of the nipples were capped with a threaded plastic cap and hot enamel poured around the cap to secure an effective seal. A copper wire was soldered to the inside of the nipple to drain current from the specimen. A holder was cut from plywood with holes of suitable size so that the coupons could be passed through the hole and a second plastic cap screwed onto the nipple. This arrangement holds the nipples in a vertical position with 20 inches of the specimen in contact with the solution. A small hole was drilled in the top cap for passage of the lead wire.

Each circular holder has space for ten test specimens. A carbon anode was suspended from the center of the holder. All nipples were 12 inches from the anode. The holder with anode and specimens was suspended over a rectangular tank containing the electrolyte. This electrolyte was made up of South Houston tap water to which had been added 3 percent by weight of each of the following materials: NaCl, Na_2SO_4, and Na_2CO_3. The resistance of the solution as mixed was 13.65 ohms/cm3.



Direct impact test. What happens after a 760-gram steel ball is dropped from a height of eight feet—once on each side of six-inch-wide sample. Unbonding ranged from 35 to 55 percent.

This value was determined by using a calibrated soil resistance box.

Cathodic protection was supplied by a six volt battery and battery charger. A 1,000 ohm (± 2%) calibrated resistance and a variable resistor were placed in series with the battery, anode and specimen. The calibrated resistor was used to measure the current drain from the nipple. The variable resistor was used to adjust current so that the specimen was maintained negative to the electrolyte by 3.00 volts with reference to a calomel electrode. The difference in potential of a saturated calomel electrode and a copper-copper sulfate electrode was approximately 0.08 volts.

The current drain from the individual specimens was measured by observing voltage drop across the calibrated shunt on a vacuum tube voltmeter which was calibrated to read directly in amperes. The minimum full scale deflection of the meter was 5 micro-amperes; the maximum, 2,500 micro-amperes. The solution-to-specimen potential was also read on a vacuum tube voltmeter.

Results—This test indicated that all hot-applied asphalt and coal tar coatings will pass a period of nine months under the conditions prescribed for this test and not conduct measurable amounts of current through the coating film.

Because of the low resistivity of the solution the entire potential measured between the specimens and the solution was across the coating film. The potential remained constant regardless of the location of the reference electrode; adjacent to the anode, adjacent to the coated specimen or in the opposite end of the tank. In a field pipe-to-soil potential measured on a coated pipe line, a portion of the observed potential constitutes current-resistance drop in the soil. The amount would depend on the resistivity of the soil and the distance from the point of contact of the electrode to the nearest holiday in the coating.

Cathodic Disbonding Test

Purpose of Test—To determine the apparent resistance of a coating to disbonding adjacent to holidays in the coating film when high electrical potentials were maintained across the coating film.

Description of Tests—The specimens, equipment and test procedures were identical with the Conductivity Test except that four 1/16-inch holidays were drilled in the holiday-free coatings. The drilled holidays were spaced equidistant on the circumference of the pipe and approximately 10 inches from the lower end.

Results—The potentials maintained on the specimens in this test were above the hydrogen over-voltage of steel. This was confirmed by the very active evolution of gas at the cathode and the bright surface of the steel in the holiday areas when removed from the test.

The asphalt-coated specimens disbonded from 13 percent to 22 percent of the total coated area, approximately one-third of the area of disbonding of other types of hot applied coatings in these tests.

High Temperature Test

Purpose of Test—To determine the resistance of a coating material to sag or flow under its own weight at elevated temperatures.

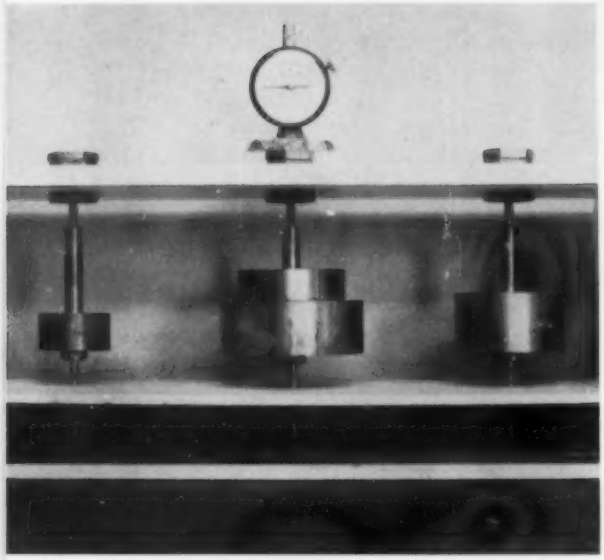
Description of Test—The coated test specimens were 6 x 6 x ¼-inch steel plates. The plates were sandblasted and the primer and enamel were applied according to the manufacturer's specifications. The coating thickness was specified to be 94 mils (± 5 mils). Each coated panel was scribed with five lines one inch apart. The specimens were then placed in an oven in a vertical position with the scribed lines in the horizontal plane and maintained at 160° F (± 5° F) for 24 hours. They were then removed, allowed to return to room temperature and the maximum sag of each line measured to the nearest 0.01 inch.

Results—All asphalt coatings passed the test with no measurable sag of the scribed lines. The lines were observed alongside a straight edge and sighting down the scribed lines "by eye" and no sag was detectable. The coating surface was smooth with no pattern of flow.

Low Temperature Test

Purpose of Test—To determine the resistance of a coating to checking, cracking and loss of bond at sub-zero temperatures.

Description of Test—The specimens used in this test were prepared in the same manner as those used in the high-temperature test. The coated specimens were placed in a cold chamber and maintained at —5° F (±3° F) for 6 hours, removed, allowed to return to room temperature and examined for cracking and disbonding.



Penetration test. Three specimens undergoing tests by penetrometer.

Result of penetration test. At left, coating has been removed down to bare metal so the thickness of the coating could be compared with the depth of penetration at right.

Results—All asphalt coatings tested passed this test with no evidence of cracking or disbonding of the coating. The bond on the specimens passing the test was checked by removing portions of the coating with a knife.

Direct Impact Test

Purpose of Test—To determine the resistance of a pipe line coating to disbonding from direct impact.

Description of Test—The coated specimens used in this test were identical to those used in previous tests. The specimens had been coated the previous day and were placed in a constant temperature water bath and maintained at 76° F for one hour prior to conducting the test. A 2 x 6-inch board with a true plane surface was placed on the concrete floor. A 6 x 6½-inch plywood board with a 3¼-inch diameter hole in the center was then placed on the 2 x 6-inch board. The coated specimen was then centered on the plywood board with the coating side up. A 750-gram polished steel ball was then dropped from eight feet striking the coated plate not less than 2½ inches from the edge of the plate. The specimen was examined in place for shattered coating. The panel was next turned over with the coating down on the support and the ball again dropped. The specimen was re-examined for disbonded coating.

Results—The percent of the total panel coated area that unbonded as a result of this test ranged from only 35 to 55 percent for asphalt coatings in these severe tests.

Indentation Test

Purpose of Test—To evaluate the resistance of a coating film to penetration by a blunt rod. This test would indicate the resistance to penetration of a coating film on an underground pipe line by rocks, dirt clods or other external pressures.

Description of Test—The coated specimens used in this test were prepared in an identical manner to those prepared in the previous tests. The tests were conducted in a room where the temperature was thermostatically maintained at 77° F. The penetration device consists of a ¼-inch blunt rod weighted with brass weights so that the load exerted by the blunt rod on the coating is 25, 75 and 150 pounds per square inch. Each bank of equipment contains one each of the three specified penetration loads. The increments of penetration are read on a spring loaded, dial reading penetrometer. The smallest scale division of the device is one-half mil. On the first day of the test, observations are made hourly. During the first month observations are read daily and weekly observations are made for the remainder of the 150-day test period.

Results—All asphalts tested on all three unit loads were penetrated an average distance compared to other types of hot applied coatings.

Soil Stress Test

Purpose of Test—To determine the apparent resistance of a pipe line coating to deformation by soil stresses which may occur when some types of soils pass through alternate wet and dry moisture conditions.

Description of Test—The coated specimens used in this test were prepared in an identical manner to those prepared for the previous test. Wooden forms with inside dimensions of 4 x 4 x 2 inches were positioned on the plates. The forms were then filled with a slurry composed of 17 percent commercial bentonite and 83 percent South Houston tap water. The specimens were then installed in a thermostaticaly controlled oven and maintained at 100° F (± 2° F) until the water had completely evaporated (or for approximately seven days). The specimens were then removed, washed and checked for deformation, cracking or disbonding by visual and electronic holiday inspection. The procedure was repeated until the specimens showed failure detectable with an electronic holiday detector.

Results—This test has not been conducted to conclusion or until all materials have shown failure by jeeping with a holiday detector. Visual observation indicates less deformation by the asphalt coated specimens than any of the others tested. No asphalt coatings have failed after seven cycles.

Soil stress test. The specimens were immersed in slurray of bentonite and water. The water was cooked out in seven days and then the sample was examined for failure. Shown here is the bentonite after seven-day cycle.

Results of soil stress test. After seven cycles, asphalt coating shows little damage.

Perhaps none of the tests give a quantitative result of the water vapor transmission rate of the various materials tested. The water vapor transmission rate of a pipe line coating is certainly very important and is one point that is most frequently talked about by those persons opposed to the use of asphalt pipe line coatings. If any methods have been devised for accurately measuring this transmission rate, they have received very little publicity in the pipe line coating industry.

The most frequently discussed method is to suspend a quantity of the coating in water for a specified period of time and weigh to determine the gain or loss in weight. This does not appear to be a very scientific procedure and does not take into account the possible solubility of the coating in water or the growth of micro-organisms on the surface of the material during the period of immersion.

If some coatings are immersed and maintained at temperatures of approximately 150° F for seven days or longer the water surrounding them will become bluish and cloudy, indicating that they are soluble at least to some small degree in water. The water surrounding other coatings remains clear. This solubility of the first mentioned coating could contribute to a loss of weight by the material.

If small quantities of asphalt coating are immersed in water for long periods of time, a very thin detectable layer of micro-organisms may grow on the asphalt coating surface. This growth could contribute to an increase in weight of the specimen.

A more scientific method was utilized by an independent research laboratory in California. In this method membranes of coatings are sealed in the mouth of a glass jar containing a drying agent. The jars were then kept in a constant temperature-humidity chamber with daily weighings to determine the amount of moisture transmitted through the membranes and gained by the drying agent. Their tests show that for equal thicknesses of the membrane the asphalt will transmit a slightly greater amount of moisture than coal tar coatings not considering specific gravity differences of the materials. However, the amount of water transmitted was so small that it is of little importance in the life of either pipe line coating.

The performance of the specimens coated with only 30 mils of asphalt coating and previously described in the conductivity test would indicate that no moisture has passed through the film. Because of the low resistivity of the solution surrounding the specimens and the relatively high potentials maintained across the film, even a minute passage of water through the film would lead to enlargement of the moisture passageway and destruction of the film. Yet no deterioration of the film has occurred for 18 months.

In addition to the laboratory testing program a series of field tests is in progress to determine the coating resistance per square foot and current required for cathodic protection of operating pipe lines located in various sections of the country. —**The End**

About the Author

Pearce R. Butterfield has been active in corrosion engineering for almost 10 years. He is presently a consulting engineer in pipe line corrosion control. Prior to start of his consulting business, he was in the Corrosion Engineering Department of Transcontinental Gas Pipe Line Corp. Butterfield was graduated from the University of Kansas with a B.S. in Civil Engineering in 1948. He was with Phillips Petroleum Company and with Trunkline Gas Company prior to joining Transco in 1952.

The 26-inch high-pressure gas line showed signs of wearing as temperature changes cause the pipe to work back and forth across the bearing plates to produce fretting. This causes corrosion. Engineers decided to install wear plates.

Epoxy Putty "Glues" and Insulates Steel Wear Plates

This method of installing wear plates leaves no trap for moisture and corrosion

By W. R. Bradshaw, President
Bradco Plastics, Inc., Houston

HEAVY, LARGE DIAMETER PIPE normally used for suction and discharge lines at compressor stations requires wear plates at each pipe support. Otherwise, the pipe will wear as it slides back and forth over the piers in response to temperature changes. This resulting fretting causes rapid corrosion and can cause pipe failure if not corrected with wear plates.

But conventional installation of wear plates by welding them to the bottom of the pipe has disadvantages. If the plates are lightly tacked in place, moisture and oxygen can accumulate between the pipe and plate and cause corrosion. If the wear plates are welded securely, they can be a source of stress and altered pipe strength.

Such a problem came up about 18 months ago at a compressor station in South Texas. A 26-inch gas line with an operating pressure in excess of 800 psi was supported in the compressor

About the Author

W. R. Bradshaw graduated from Texas A&M College in 1950 with a B.S. degree in Architectural Engineering. He worked for seven years as a research and development engineer in the organic development laboratory of The Dow Chemical Company's Texas Division at Freeport, Texas. He was named president of Bradco Plastics, Inc., in 1958.

station yard by sleepers spaced about 15 feet apart. There was evidence of wear at each bearing plate. Because of the welding problem and the necessity of jacking up the pipe sufficiently to weld it, engineers decided to "glue" the wear plates with a new epoxy putty.

This putty has some highly desirable characteristics. It has a tensile strength of 10,000 psi, a tensile shear strength of 3,500 psi and a compressive strength of 30,000 psi.

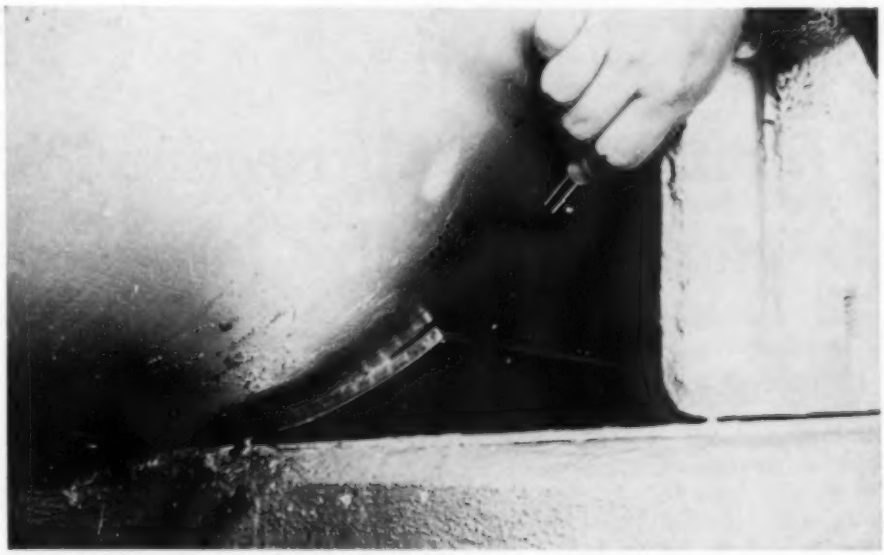
Here's how the wear plates were applied to the under side of the pipe: The inside of the plates were smeared with the epoxy putty—a trowel was used, and the thickness of the coat was about 10 mils. The pipe was jacked up slightly and the plates were slipped between the pipe and the bearing plates. The contact pressure exerted by the pipe when it was released from the jacks was sufficient to provide adequate bonding.

No further treatment of the installation was necessary. The putty required an initial curing time of 5 hours at 90° F. The complete curing time is 24 hours at 90° F.

The plates were inspected some 14 months after they were installed. Not only was the epoxy holding as an adhesive, it was also serving as a filler to prevent any corrosion at the bottom of the pipe.

Had engineers desired it, the epoxy putty could have been used to insulate the pipe from the wear plate and bearing plate. It would have been necessary to shim up under the pipe with insulating material until the epoxy took its initial set.

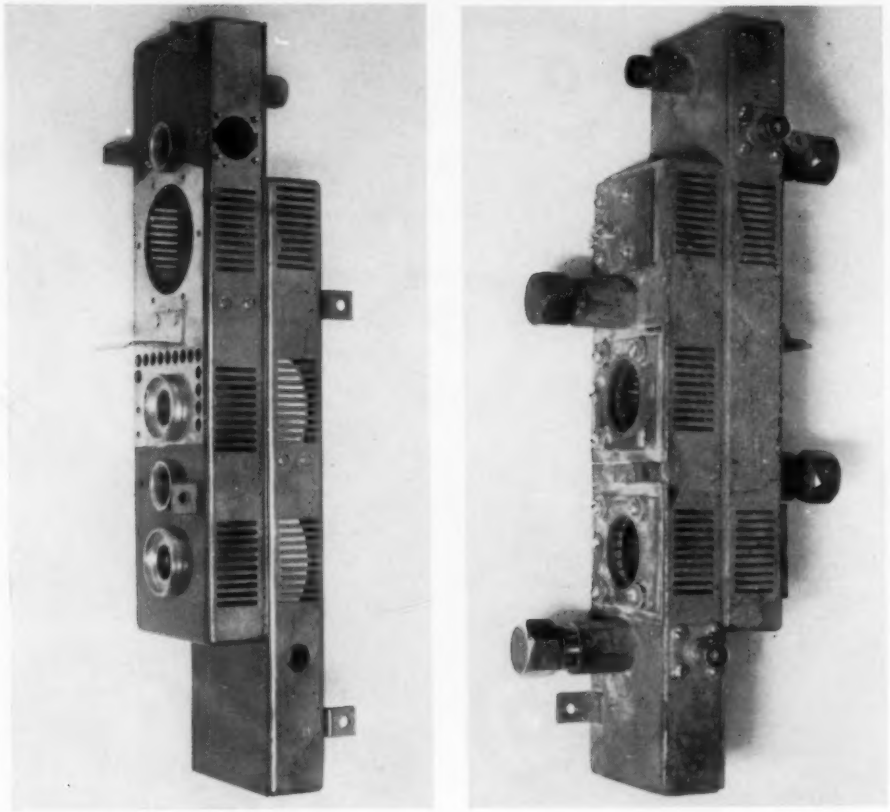
Wear plates were "glued" to pipe by epoxy putty adhesive. In this case no attempt was made to maintain electrical insulation, so the weight of the pipe was allowed to provide bonding pressure. Insulating shims under the pipe could produce excellent electrical insulation.



Setting time for the epoxy is 5 hours at 90° F for initial set; 24 hours at 90° F for final set. The space between the wear plate and pipe line shown here is filled with epoxy putty. This keeps moisture from collecting to cause corrosion.

This simple solution to a common problem in the pipe line industry, illustrates the versatility of the epoxies.

—The End



BEFORE AFTER

This dramatically illustrates the ravages of corrosion in areas where H_2S is in heavy enough concentration to have a perceptible odor. Even after the buildings housing the radio equipment were carefully sealed, the air had to be filtered because of the admission of the corrosive gas each time the door was opened.

Maintaining Microwave In Highly Corrosive Areas

The air contained so much H_2S that even gold had to be protected against attack

By Charles G. Fuller, Jr.
Permian Division
Communications Engineer
El Paso Natural Gas Co.
Jal, N. M.

FOR SEVEN YEARS El Paso Natural Gas Co. "communications pipeliners" have faced the problem of maintaining microwave equipment in a severely corrosive atmosphere. The company has operated a 21-station microwave system in New Mexico and West Texas where concentrations of H_2S are high enough on occasion to attack almost any metallic surface, even gold to some extent.

The operating procedures described here were developed during the 3½ years of initial operations of this system. They have proved highly successful in dealing with the problem of airborne attack and the same procedures were instituted on a 16-station system recently added to the original installation.

Ideal vs Actual Operating Conditions. Ideally, radio equipment should be installed in an atmosphere of temperature controlled, pure, dustless air with a voltage and frequency controlled primary power supply. It is standard procedure to install some means of providing the voltage and frequency stability requirement, but comparatively little is done about the atmospheric conditions. The design of modern microwave equipment specifies an operating range in the area between —4°F to + 122°F, but these are the absolute limits—not optimum operating values.

The use of silver plated surfaces in radio frequency plumbing, tube sockets, relay contacts, etc. implies that such equipment be installed where silver is not attacked. This is an unfortunate choice in contact material. "Tarnishing" of silver occurs almost universally in the United States to some degree or other with the possible exception of desert and high mountain areas.

OPERATING WHERE THE AIR CONTAINS H_2S

In the oil and gas area comprising the Permian Basin of West Texas and Eastern New Mexico, there are high concentrations of hydrogen sulfide or "sour" gas in many of the underground reservoirs. This contaminant requires complex treating installations for its removal, and in the process, minute quantities of the gas are released to the atmosphere (a few parts of H_2S per one billion parts of air). So corrosive is it that concentrations too minute to be detected by the human nose are sufficient to cause great damage to both silver and copper. But in some areas of the Permian Basin, where the concentration of H_2S and other mercaptans is much greater and the odor is quite pronounced, the corrosion problem is very severe.

The consequences of operating radio equipment in this type atmosphere are illustrated in the photos. Complete deterioration of equipment

and loss of operation are certain to come if no preventive measures are taken. Specifically, noisy circuits and complete outage of communications can result due to loss of Q in RF resonant circuits, tube socket contact failure, relay contact failure and corrosion of antennae and feedline fixtures.

Background and the Tube Wiggle. Initially, the El Paso system was installed in concrete block buildings of conventional construction. No particular attention was paid to minute openings to the atmosphere. In fact, the ventilation required to cool the equipment was raw air furnished by intake blowers.

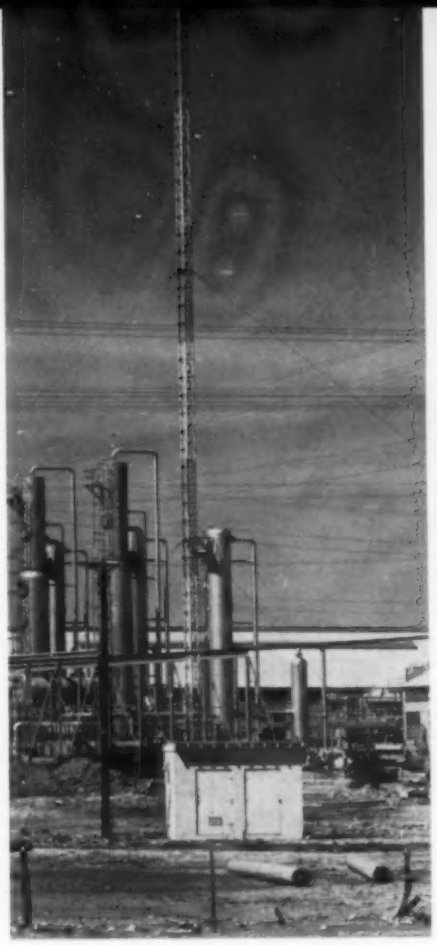
The first indications of corrosion came when the causes of noisy circuits were traced to receiver and transmitter tube-socket corrosion. A temporary solution to this problem was developed. Periodically the tubes were wiggled in their sockets. This temporary measure solved the problem, but it was obvious that a long term solution had to be found to avoid wearing out the sockets.

Deterioration of the transmitter cavities was also a problem. It resulted in actual loss of power output, and long periods of system outage were sustained. The cavity problem became so acute that it became necessary to turn each station off weekly to clean the tube contacts and mating surfaces abrasively. This removal of power resulted in increasing the outages as component failure increased due to removal and reenergization of power supplies to these equipments. It was necessary to adopt these measures, however, in order to maintain service until preventive means could be found.

THE ATTACK ON SILVER AND GOLD

Because most of the difficulties originated with silver surfaces in the transmitter units, it was decided to attempt another plating material which would inhibit the corrosion. Gold, lacquer and rhodium were tried with varying degrees of success, none the ultimate.

Gold produced a sulfide which was practically non-conductive. The Q of the cavity was lowered to the extent that many new tubes would not sustain oscillation, and the corrosive conditions still prevailed.



Radio equipment is housed in the white building in the foreground. Only a few hundred feet away is the source of H_2S. Plant flare burns H_2S but a portion still escapes into the atmosphere. For this reason the radio equipment must be carefully protected as described here.

Lacquering the surfaces which did not require electrical contact improved the situation immensely, but lowered the cavity Q considerably and was not generally satisfactory. Of course, the tube mating surfaces and the contacts themselves could not be lacquered so they were covered with silicone grease. Operable conditions resulted and the crash program of maintenance slowed to the point where it could be reviewed. Incidentally, the contact greasing had a side detrimental effect, in that the grease collected dust and outages resulted from this.

Next, rhodium plating was tried. But this merely extended the operable time from six months, in the case of silver and gold, to about 15 months. At the end of this period it was necessary to completely disassemble the units, sand blast and replate each cavity. Needless to say, this procedure was and still is expensive. In some cases, the cavities were so badly corroded they had to be replaced—more expense.

Of course, plating the transmitter cavities did not alleviate the situation in the other equipment. Receivers, baseband amplifiers, power supplies, terminating panels, carrier equipments, etc., required constant cleaning to remain operable. Nevertheless, the above steps reduced the urgency of the situation, and it became possible to search for a means of eliminating the trouble.

SOLUTION: SEALING, COOLING, FILTERING

Several years before, the possibility of air purification had been considered, but it appeared too expensive. As the seriousness of the situation became apparent, it was decided to investigate the possibility of isolating the equipment from the atmosphere as much as possible.

Two stations in severe locations were picked for experimental work. One was fitted with a squirrel cage blower which pulled outside air through a charcoal filter and exhausted it into the manifolds of the transmitter assemblies. But it soon became apparent that a filter large enough to do an effective job would be impractical.

The next approach was to completely seal the interior of the equipment house against external air. All cracks, vents, door sashes, etc. were sealed by caulking all seams. Vinyl weather stripping was used on the doors. This sealing was continued until it was impossible to observe any light coming in from the outside with the door closed and interior lighting extinguished. A double layer of insulation was used on the ceiling with generous applications of plastic caulking. A refrigerative air conditioner was then installed to maintain the ambient temperature at a practical (85°F). **These two steps produced the most effective and dramatic results of all.**

LONGER TUBE LIFE—BETTER PERFORMANCE

The corrosion rate dropped almost 95% in almost every case. When all stations in the system were modified in this manner, service improved enormously. Several interesting im-

provements were also experienced:

The weekly turn-offs were no longer necessary, and the stations were allowed to run continuously after a thorough cleaning of all surfaces. The total tube usage for one year dropped an average of 70 percent below that of the previous year.

This performance has continued. The average life of a 2C39 tube has been extended from the previous average of five months to more than a year. Two elements contributed to this: (1) controlled temperature and (2) continuous operation. Prior to cooling the houses, maintenance personnel had experienced extreme degradation in receiver/modulator equipment causing severe cross-talk of the intermodulation distortion variety. Apparently, the temperature extremes from zero in winter to 130°F in summer had caused components to age severely. This required alignment of equipment at least once a year. The temperature improvement factor is indicated since no corrosion is experienced in the affected components such as coils, capacitors and resistors which have not been replaced.

CONTINUOUS FILTERING

The corrosion by this time had been greatly reduced but by no means had it been eliminated. Heartened by the improved conditions, steps were taken to completely reduce all possibilities. One of the remaining sources of corrosion was the weekly visits by maintenance personnel that required opening the doors of the buildings. This allowed a renewed charge of contaminated air with its accompanying corrosion.

Some method of removing the contaminant from the inside of the buildings was indicated. Charcoal filter-blowers with a capacity suitable to recirculate the air every ten minutes were installed and resulted in an almost complete solution. The deterioration rate has been reduced from a few months to a matter of years.

Subsequent installations have been made using the sealing-cooling-filtering techniques without special treatment of the radio equipment (silver surfaces left unplated or covered) and an extremely small amount of corrosion has resulted. In fact, the environments now closely parallel installations in other parts of the U. S.

CORROSIVE 'NON-CORROSIVE' REGIONS

Observations have been made in areas previously considered non-corrosive. One such station is located on the side of a mountain at approximately 6000 feet in elevation, about 3000 feet above surrounding countryside and over 100 miles from any oil or gas production. This station exhibited an extreme amount of corrosion after three years of operation necessitating complete cleaning. Investigation showed that gas from mine shafts in the vicinity was causing the trouble. A charcoal blower filter alone would probably cure this difficulty.

MAINTENANCE OF CORROSION MITIGATION EQUIPMENT

Charcoal Replacement. It has now been determined that replacement of the charcoal granules in the blowers is necessary at various periods depending upon the degree of H_2S concentration. The cost of this replacement and the cost of operating the air conditioners is far offset by the elimination of the expensive measures previously required.

Ultrasonic Cleaning. During the process of reaching the present status, many methods of cleaning radio equipment have been utilized. Presently the most inexpensive and practical is the use of a commercial silver cleaning solution in an ultrasonic cleaning tank which has reduced the manual operation to a minimum. Complete disassembly is no longer required; a mere immersion in the "sound-blasting" tank is enough.

Half Measures Are Not Suitable. The original installation of rigid copper transmission line commenced failing after three years of operation. These lines had been covered by a protective layer of paint and had been taped at the joints. The failure illustrates the fact that half-measures are not suitable in that the application of doped-tape did not prevent the entrance of minute particles of hydrogen sulfide from entering. The co-ax was pressurized with nitrogen, and a constant program of preventive maintenance was carried out to prevent leaks.

Eliminating connections. It finally became apparent that what was needed was a feedline with a minimum of joints or connections. The rigid line had developed noisy and high resistance connections at each point of connection. As a result, the entire system's feedlines were replaced with the type of feedline constructed from aluminum sheath, polystyrene dielectric and copper inner-conductor. This line employs one connector at each end. These connections were covered with seven to eight layers of tape and the tape was coated with a plastic liquid sealant to prevent any leakage. These lines have operated completely satisfactorily with no pressurization. It must be borne in mind that the humidity encountered in the areas of operation of these systems is extremely low, and that such non-pressurization in high humidity areas should not be contemplated.

The cost of operating a system using the methods described here is slightly more than normal, but is decidedly not prohibitive. The results are high quality service with only slightly more maintenance than in "normal areas." **The End**

About the Author

Charles G. Fuller, Jr., is El Paso Natural's division communications engineer for operations and maintenance in Texas and New Mexico. Prior to joining El Paso in 1954, he operated a television repair business; worked in the Guided Missile Program of the U. S. Army. Fuller attended Benjamin Franklin University, served as radio officer in U. S. Merchant Marine in World War II and had industry experience as communications foreman and as Technician with Mobil Radio, Inc.

87th Congress holds these

Keys to the Future of the Pipe Line Industry

In exclusive Pipe Line Industry interviews, top legislative and industry leaders discussed these major issues to be considered in the next four years. Here is your chance to survey the big hurdles ahead for the industry

THE PIPE LINE INDUSTRY has no elaborate program of requests for new legislation from the 87th Congress, or for immediate policy changes from the new chief executive. Thus, the industry's attention centers on potential federal action concerning:

- Natural gas regulation
- Area pricing of natural gas
- Reorganization of regulatory agencies
- Minimum wage
- National fuels policy study
- Imports
- The 27½ percent depletion provision

These issues are receiving "acutely alert" attention from those the industry depends on for accurate evaluations. Let's look at these key problem areas.

Natural gas bill . . . *little hope for action in 1961*

Leaders and spokesmen for oil and gas continue efforts to induce Congress and the executive branch to initiate natural gas legislation.

Shortly after the 87th Congress convened, a natural gas bill (HR-24) was introduced which was identical to HR-366, introduced two years ago. The new bill calls for a fair market price for producers' gas and contains some amendments supported by coal spokesmen. Also, bill HR-172 was introduced to free producers from federal control of natural gas prices. Despite these efforts, prospects for a new gas bill during the 87th Congress are from dim to hopeless.

"A bill similar to those presented to Congress in the past wouldn't have the chance of a snowball in hell," says a realistic and high-placed Ways and Means Committee member from a gas-producing state. And, he would like nothing more than to see such legislation passed. "While there seems little or no chance to interest Congress in the type of bill passed in 1956, the natural resources and fuels policy studies the President advocates may open up a new, productive approach to gas legislation.

On the other hand, Congress will be urged to further tighten controls over gas prices and independent gas producers. One indication of this is a bill recently considered by the National Association of Railroad and Utility Commissioners. It would stiffen controls over both producers and pipe lines, and require the FPC to expedite its decisions. While such bills may not get far in Congress, the viewpoints they present do not improve the climate for new laws favorable to natural gas.

There is a revitalized industry movement to take a new tack in gas legislation strategy. It would include an "educated" gas-consuming public. This public would combine with industry people in a drive to alert the nation and its lawmakers to the need for incentives encouraging natural gas exploration and production.

The campaign would be open—a covenant for conservation, with consumer interest featured.

FPC's area gas policy . . . *can it survive the court tests ahead?*

Another area of uncertainty, is the FPC's new area pricing system for independent gas producers.

Last year when FPC Chairman Jerome K. Kuykendall said the agency's new policy on area pricing would "open the door to a new era in the natural gas industry," he was right. Before a month had passed 13 companies filed requests for FPC action to:

- Initiate proceedings leading to a review of the geographical areas prescribed
- Promptly adjust upward the guide levels applicable to increases under existing contracts
- Abolish the dual price levels for old and new gas contracts as soon as possible

Both the commission and the industry expect the FPC's decision in the Phillips and similar cases to be reviewed by the Court of Appeals—then by the Supreme Court. Congress could eliminate much trouble and confusion, but action is not likely.

President Kennedy is in a position to completely change the complexion of the FPC majority by mid-year. But what the industry must live with now

is the present decision in the Phillips case and the new policy and price system announced with it.

The general industry view in Washington is that the new area price policy may create more problems than it solves, i.e., what will happen to the new price structure if the courts decide against area pricing? The outlook is not a happy one.

Regulatory agencies . . . *greater federal control of business*

In his recent scathing report on federal regulatory agencies, Presidential Special Assistant James M. Landis had this to say about FPC:

"The FPC . . . represents the outstanding example . . . of the breakdown of administrative process. The complexity of its problems is no answer to its . . . failure.

" . . . These defects stem from attitudes of unwillingness of the Commission to assume its responsibilities under the Natural Gas Act . . . and of refusing in substance to obey the mandates of the Supreme Court . . . and other federal courts." Landis calls for the following changes in agency structure:

1. Legislation empowering the President to propose reorganization plans for the agencies.

2. Set up three departments in the President's executive office to develop and administer policies covering energy, communications and transportation—plus a fourth department encompassing all regulatory agencies. In short, tighten federal control of business and industry.

Although stiff opposition is expected in both House and Senate, Landis's sweeping proposals are expected to create a "new look" in government-industry relations even if sought-for legislation is not passed.

Minimum wage . . . *favorable action on the way, despite opposition from Conservatives*

In addition to a higher minimum wage and broader welfare programs, labor leaders want tangible White House recognition for organized labor across a wide spectrum of government organization here and abroad. They seek status and footing in federal affairs equal to business and industry.

These appeals, it is generally agreed in Washington, are encouraging attentive and sympathetic ears in Congress and in the Kennedy administrative organization.

As part of a massive economic pump-priming program, President Kennedy early in February asked Congress to raise the minimum wage from the present $1 an hour to $1.10 an hour immediately and to $1.25 an hour within two years. He also is asking extension of minimum wage law coverage to "several million" new workers.

A solid front of labor and liberal congressional support is taken for granted. It is in the area of minimum wage legislation that the strength of the Southern Democrat-Republican coalition is expected to be tested in the early days of the 87th Congress.

National fuels policy study... *more than a dozen resolutions in the hopper*

President Kennedy completely supports a national fuels policy study. He has tied it to the depressed coal mining area rehabilitation program. He has related it to both a natural resources and conservation survey, plus cost-of-living studies at executive and administrative levels.

Late in February, the author of a resolution calling for a national fuels policy committee in the House, Rep. Wayne Aspinall (D-Colo.) held up floor action on the measure. The resolution had passed the House Rules Committee, and it looked like it would reach full House membership the last week in February. But Aspinall withdrew the request to await Senate reaction. Meanwhile, oil industry leaders took solace in the fact that the fuels policy decision was in the hands of a special House Committee, where Speaker Sam Rayburn, who is kindly disposed to oil's position, has some control over the situation.

Coal's campaign for the study, led by the National Coal Policy Conference, has been intense and effective. It has been held up by petroleum leaders as a prime example of what united and concerted organization can do. Despite wide support in Congress, members from oil and gas producing states tabled the legislation in the House Rules Committee last year.

However, spokesmen for oil and natural gas industry appear to have shifted their aim for the 87th Congress. They will attempt not to kill the proposal—but to circumscribe it. They will strive to see that whatever investigative groups emerge from congressional or executive action will not be completely dominated by the coal industry's views.

Most oil and gas leaders regard the proposed study as a dynamite-laden sleeper which will attempt to further centralize government control over the nation's energy sources and fuels supply.

Oil import program . . . *alterations can be expected*

Washington observers won't be surprised if the entire issue of mandatory oil import control is not fought all over again in 1961. The complex problems of policy will likely be added to the Administration's many problems.

But until there is a chance for those taking over regulatory jobs to study the complexities of setting up new limitations and allocations, no early or drastic changes are likely.

Pressure from industry groups is sure to result in demands for alteration of the program. Some feel the program has gone too far in protecting domestic producers and coal. Others feel the basic formula controlling imports should be changed. Still others want a change in allocation policy. The elimination of basic provisions of the imports plan would result in challenges in the courts—thus jeopardizing the entire program.

The President has made no commitment on the oil import policy he will recommend, but he has commented on factors affecting it. These include vitalizing the domestic economy, consumer prices, and small-business protection. He is aware of the views of those what want residual quotas increased and he well knows coal's position regarding increased residual imports.

Depletion provision . . . *time to prepare for a stiff battle ahead*

New bills to cut or eliminate depletion are in the hopper, but the oil industry has a breather to prepare arguments because of several factors, including the President's intention to study natural resources taxation before making recommendations.

No competent observer in Washington looks for the depletion provision to be safe through 1964. Anticipating this, Gulf Oil Corporation has started an educational campaign slanted toward the depletion provision for overseas.

—The End

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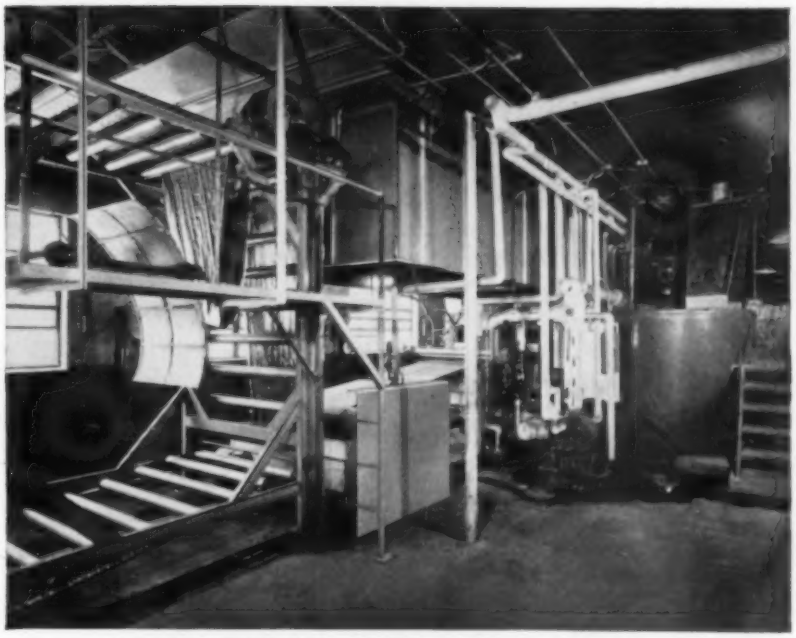

View of specially-designed machine developed after five years of research by Tapecoat engineers to convert raw materials automatically into TAPECOAT 20.

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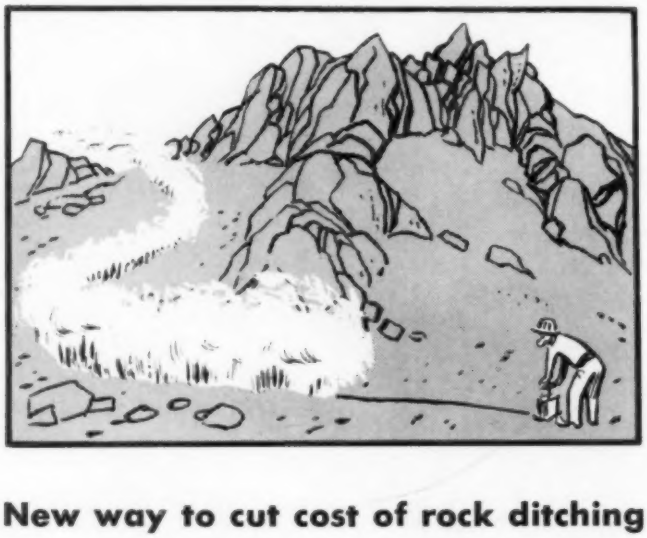
Ideas for the Future

By Donald M. Taylor, Engineering Editor



New way to cut cost of rock ditching

If you're a pipe line contractor, here's a way you might be able to save money sometime.

Not long ago a contractor was laying a system of gathering lines in the caliche country of southwest Texas. Instead of drilling and blasting, he ran a light tractor with a ripper along the right-of-way, cutting a narrow trench about 2-inches wide and about 8-inches deep. He placed Primacord in the bottom and poured ammonium nitrate on top of it and then sensitized the explosive with diesel fuel.

When he set off the blast, he had a ditch about 8 feet wide and 3½ feet deep which was sufficient for his gathering lines. He crumbed out the ditches, laid the lines and backfilled them. He made a sizable profit on the job, thanks to this lazy man's method of ditching.

Helium and neon mixture used to produce optical gas maser

Unlimited spectrum for communications lies ahead, thanks to masers which have been developed in the past year. Another possibility is that the path they have opened up could lead to development of the so-called "death ray", because they make it possible to focus coherent light on an extremely small area. Their greatest use however, lies in their ability to span great distances with a small amount of scattering and spread of the beam. (See February 1961, Pipe Line Industry, Page 50).

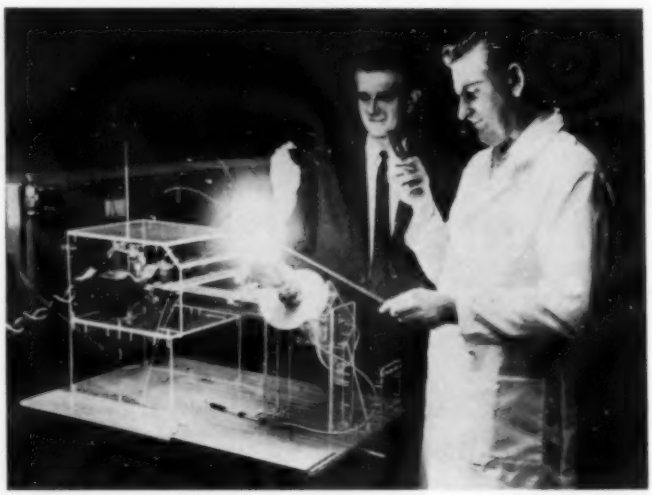
The newest development in the field of masers comes from Bell Laboratories. Using a 40-watt radio-frequency to excite a mixture of helium and neon in a tube, scientists have produced an optical gas maser which can operate at room temperatures, producing coherent infrared light at five different wave lengths between 11,000 and 12,000 Angstroms.

The original masers used were crystals such as rubies which emitted coherent light in pulses. Next came calcium fluoride crystals adulterated with uranium or samarium that emits continuous light, but must be operated at extremely low temperatures.

New organic solids have low electrical resistance

Will organic compounds replace metallic conductors? It's possible. Recent developments in DuPont's Central Research Department may be pointing the way, according to an article published in *Chemical and Engineering News,* Jan. 9, 1961. Salt-like solid compounds which are anion derivatives of tetracyanoquinodimethane (TCNQ) have electrical resistivities ranging from 0.01 to 100 ohm-cm. This compares with 10^{10} to 10^{14} ohm-cm for most organic compounds.

Who knows, maybe organic compounds inside plastic pipe may prove to be the most economical means of transporting electrical power?



Fuelless torch generates temperatures of the sun

A plasma torch that generates heats approaching the temperatures of the sun consumes no fuel and is virtually maintenance free. A prototype unit, built by Amperex Electronic Corp. at a cost of only $1,000, has already produced temperatures above 5,400° F. Experiments are now under way to achieve temperatures above the 10,000° F range which is approaching temperature of the sun's surface.

How does the torch work? A high frequency electromagnetic field breaks up and ionizes nitrogen molecules into their component atoms. Gas in this form is called a "plasma". When the atoms re-combine into their original

state, the absorbed energy is liberated in the form of heat.

Surprisingly, none of the parts of the torch heats up. Immediately after the system is turned off, the parts are found to be cold. Thus there is little wear and tear. The only part that will ever have to be replaced is the magnetron tube used to generate the electromagnetic field. Its cost is only $20.

Without doubt, this torch could find many uses on pipe lines it can be made rugged, lightweight and *a little cheaper.*

What copper sulfate can do for asphalts and coal tars

Republic Chemical Corp. has filed for patents which enumerate 14 new uses for copper sulfate. According to Republic chemists, addition of copper sulfate in the treatment of asphalts, bituminous materials, coal tars etc. causes an increase in the formation of desirable high-molecular weight asphaltenes, etc. This makes for unusually high fluidity of asphalt at elevated temperatures and desirable non-brittle rubber-plastic qualities at low and freezing temperatures.

Fertilizer used to start jet engines

Ammonium nitrate, the fertilizer that doubles as a powerful explosive, is being used in a propellant cartridge for starting jet aircraft engines. The unit, developed by Rocketdyne, Division of North American Aviation, is rated at 430 hp for a period of 17 seconds. This starter is said to eliminate ground starting installations.

Frying pans with teflon need no fat

Now we can buy greaseless frying pans which are lined with teflon. The slick internal coating prevents sticking.

This new pan was developed in France, and to all intents and purposes, the pan is very much like any other except for its super slick interior.

Computer designs computer

More and more design problems have been turned over to computers, and finally, the design of one computer was turned over to another computer. Engineers with Bell Laboratories have used one digital computer to produce the logic network of another. The first one produced wiring diagrams, parts lists, assembly instructions etc. of a computer which will be used in tests of the Nike-Zeus anti-missile missile.

Sell reservations and retire— Stanford Research tells Indians

Naturally, the Colville Indians hired a research outfit when they learned they were being liberated from federal supervision. They wanted to find the best way for the red man to seek status among pale faces and earn *wampum* for compacts and firewater.

As a rule, the services of Stanford Research Institute are purchased by nations, kings, presidents and pipe line companies. But regardless of who buys, when the grant money is on the line, Stanford scientists come up with the exemplary solution to any problem. They outdid themselves for the Indian tribes living on the Colville Reservation in the state of Washington.

For they found a short cut to the *happy hunting grounds.*

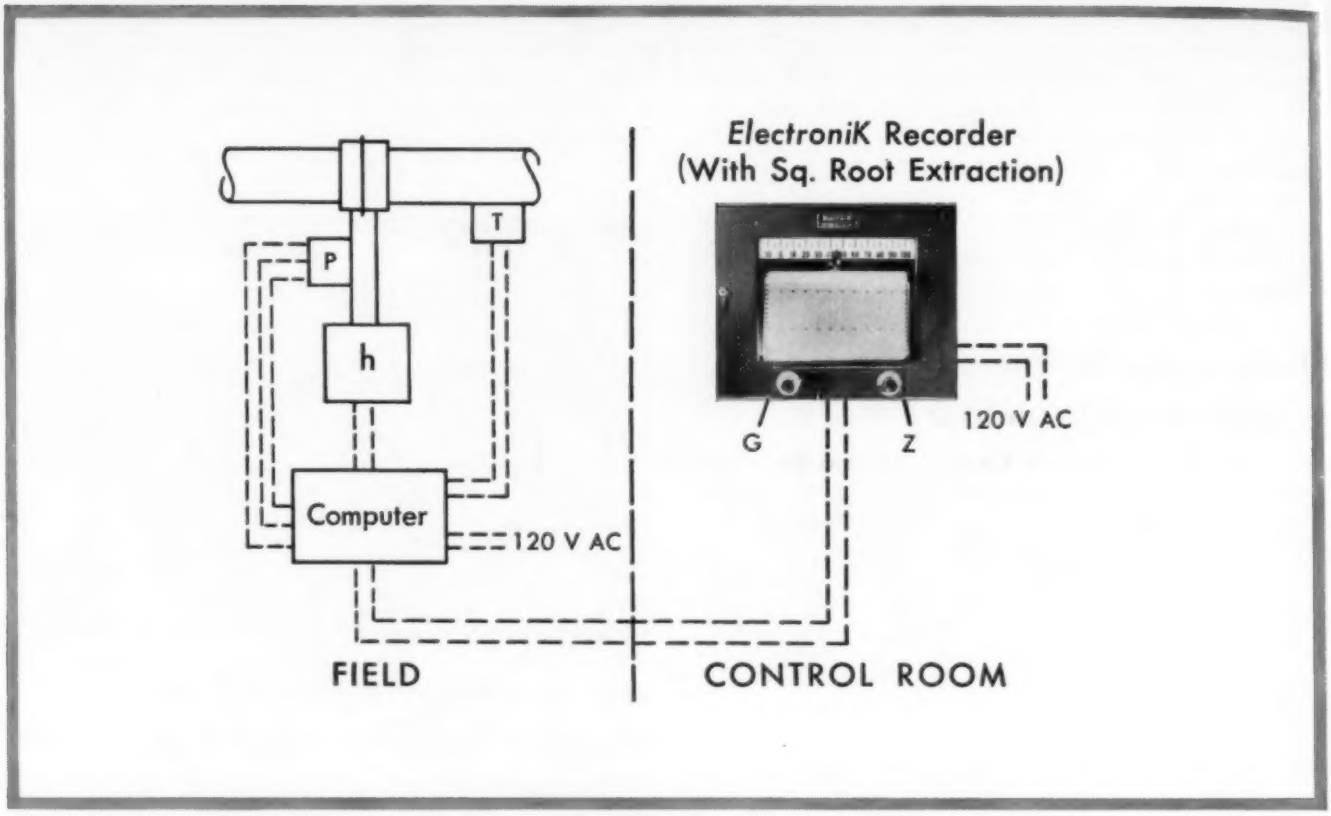
Here are the SRI findings: 1. Forget the work bit. At best, all 1,300 braves of employable age could earn only $1.3 to $2.18 million per year, and even this would be subject to Great White Father's ravenous tax collectors. 2. A better plan is to sell the reservation—its 1.35 million acres will bring $40 to $100 million—invest proceeds in securities and mutual funds, and live off $5 million per year income.

Thus, the Indians can earn twice as much by not working. Of course, if the red men want to *work* to augment their incomes, why they'll have only themselves to blame when the "revenooers" come for their collective scalps come April 15!

Are you corrosive? Many people are

You may be corrosive. Many people are. Eastman Kodak Co. scientists find that there is a great deal of variation among different individuals. Some have a touch that causes steel to rust. Others do not.

For the acid "touchables" there are remedies. They should drink more water, eat less salt and work in cool places. Otherwise, they'd better wipe the objects they handle free of fingerprints.



New Honeywell all-electric Gas Flow Computer

measures and records mass flow rate automatically and continuously

Here's how the Honeywell gas flow computer solves a gas flow equation:

$$Q = K\sqrt{\frac{hP}{TGZ}}$$

Where **Q** = mass rate of flow, scfh
h = differential pressure, inches of water
P = static pressure, psia
T = flowing temperature, °R, (°F + 460)
G = specific gravity
Z = super-compressibility
K = orifice flow constant

The *ElectriK Tel-O-Set* △P/I transmitter measures *h*; an absolute pressure transducer measures *P*; and a resistance thermometer bulb measures *T*. The analog computer multiplies *h* by *P* and divides by *T* . . . and sends a resultant millivoltage to the *ElectroniK* recorder. The recorder applies the correction factors *G* and *Z*, extracts the square root, and records the resultant mass flow Q.

Easily linked to telemetering and remote control systems, supervisory control, data handling and industrial process computers.

No more tedious, time-consuming calculation of gas flow. This versatile gas flow computer does it for you . . . automatically, continuously. It measures and records gas flow in terms of standard cubic feet per unit time, and is the only all-electric system of its kind.

The Honeywell gas flow computer consists of an *ElectroniK* strip chart or circular chart recorder, a power supply, a standard resistance thermometer, an absolute pressure transducer, a voltage-divider type computing circuit, and an *ElectriK Tel-O-Set* differential pressure-to-current transmitter. The transmitters, transducers and computing circuitry can be mounted *near the orifice*, and only two wires bring the signal into the recorder in the control house. Field-mounted equipment available in explosion-proof housings.

There are many optional accessories. The recorder can be supplied with pneumatic or electric control, retransmitting slidewires, digital encoder, motor or servo-driven control index or pneumatic *Indexet*, hi-lo alarms, auxiliary contacts, pulse telemeter transmitter, and many other options.

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How to do it

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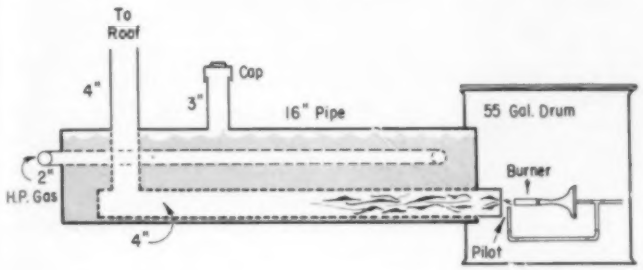


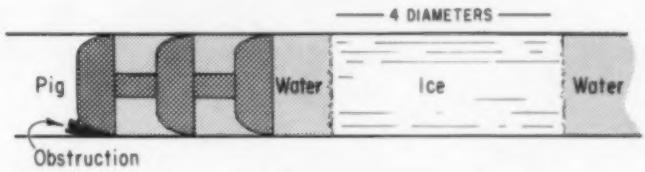
Use Large Pipe and Drum To Make Water-Bath Heater

A water-bath gas heater can prevent freeze-ups in gas regulator stations in the cold country. Here is one that has served admirably for several years in the cold winters of Nebraska.

As shown in the accompanying drawing, the burner section is mounted inside the drum which is cut to the desirable height and equipped with a manhole cover which can be locked in place.

Flame from the burner is directed down a 4-inch pipe which runs the length of the 16-inch pipe, turns upward to form a flue. The 16-inch which is filled with water, has a four-inch riser which is capped to prevent bugs, etc. from getting into the water. A loop of 2-inch gas pipe runs through the 16-inch pipe as shown, and it is immersed in water for maximum heat exchange.

One word of warning, the high-pressure gas regulator should not be within 10 feet of the burner.



Freeze Ice-Plug in Line To Save Scarce Test Water

When the pig ahead of the test water becomes jammed, and you must cut it out of the pipe line, pack a section of the pipe 8 or 10 feet behind the pig with dry ice and backfill it until the water freezes a solid plug in the line. Then you can cut the line, remove the obstruction and re-insert the pig without losing the water.

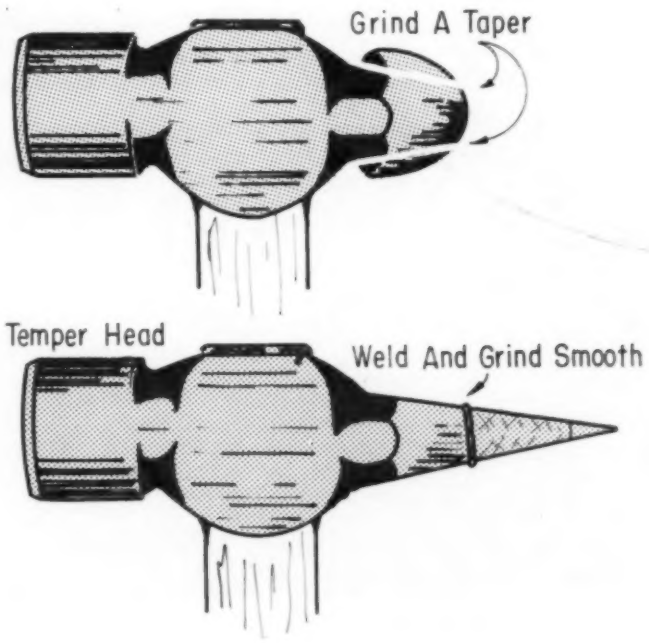
There are several advantages to this method: First, water may be scarce—at any rate filtered water is valuable—and this method saves all but a few gallons. Second, the water does not get loose in bell-holes and ditches and this makes it more convenient for welders.

When you decide to use an ice plug here are some rules of thumb you should keep in mind:

1. The length of ice plug should be about four pipe diameters.

2. The amount of dry ice required to freeze a plug runs about 1½ pounds per square inch of the inside area of the pipe.

3. After the ice plug has served its purpose, a heating torch will soon dislodge it, so pigging and testing can proceed.



Convert Hammer to Center Punch for Pipe Fabrication

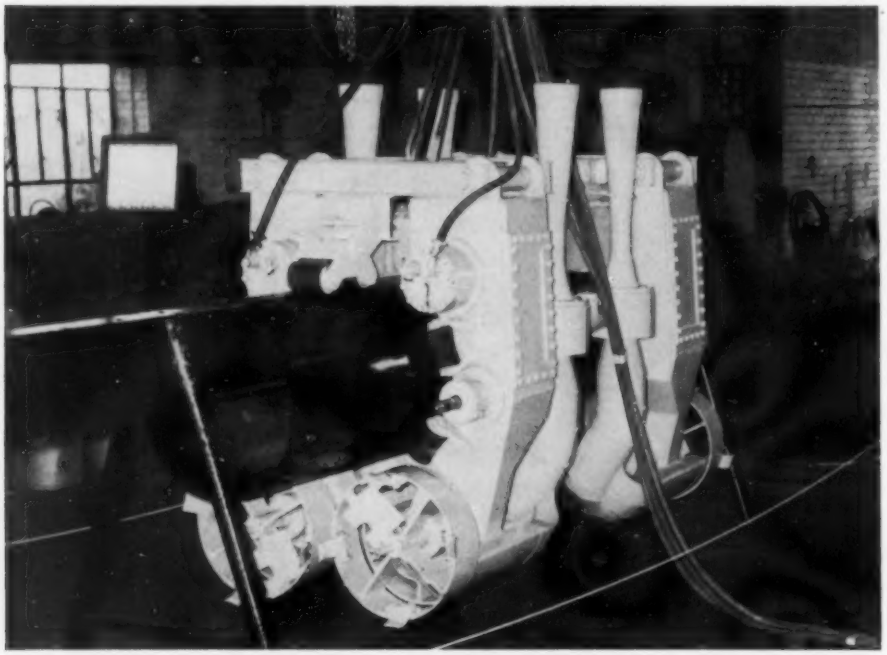
Grind a taper onto the round end of a ball peen hammer, weld the tip of a heat-treated center punch to it and you have an excellent center punch for pipe fabrication.

After making the weld, grind the end of the hammer to a smooth taper and sharpen the pointed end to suit. For pipe fabrication a second hammer is used to strike the center punch to make the mark in the steel. Because you will have hammer striking against hammer, it will be wise to temper the center punch by heating it to about 1,000° F. This will minimize the danger of flying steel particles.

This hammer will make a handy addition to the pipe fabricators tool chest.

WHAT'S HAPPENING IN PIPE LINE CONSTRUCTION

By Donald G. DePugh, Construction Editor



En route to Venezuela for river crossing job

Tellepsen Construction Develops New Submarine Trenching Machine

Tellepsen Construction Company will bury a 24-inch crude line submarine river crossing under the Orinoco River in Venezuela with a newly developed undersea trenching machine.

The machine is simple in construction and operation. It consists of four rotating cutter heads placed on ends of arms which are hydraulically opened and closed to fit around the pipe. Rubber rollers on the inside of the arms are the only parts which come in contact with the pipe. The machine is started on the pipe by a diver. With cutter heads on both ends of machine, it can move forward and backward to make the proper size ditch in smooth and even gradations. Cutter heads, which revolve in opposite directions, are slightly larger than half the pipe diameter, each cutter is half trench width.

Each cutter is driven by two hydraulic motors mounted on top of the arm. A chain drive links cutter with motor. High pressure water eductors remove material from behind the cutter heads to be deposited on both sides of the ditch. All four suction pipes can be manifolded and material carried up to the surface and deposited from a barge. High pressure water jets also are used on each cutter head to keep the blades clean and break up large solids at the suction intake. At mid-point of the arm a small cutter head can be attached to the small rotating shaft. This cutter keeps material from falling into the ditch.

The machine is remotely controlled from the surface and movement along the pipe is accomplished by a winch on the barge passing around suitable anchor ahead and attached to the dredging unit. Simultaneous movement of barge and dredge is effected with anchor winches.

The 24-inch crude line for Phillips Petroleum Company with conventional and concrete coating will have an outside diameter of 31⅝ inches. The 4,500-foot crossing will be buried from 15 to 35 feet beneath the river which reaches 100-foot depths.

The trenching machine is used after the line has been laid on the bottom of the river. A 5-foot high buoy drum is placed on top of the machine to take weight off the pipe. Total weight of machine with the buoy is 19,000 pounds. The buoy is under air pressure to offset external water pressure. It also helps balance the trencher over the pipe. The machine is 10-feet high, 6-feet wide and 10-feet long. This model will handle pipe up to 24 inches.

Brown & Root Awarded Arabian Gulf Projects

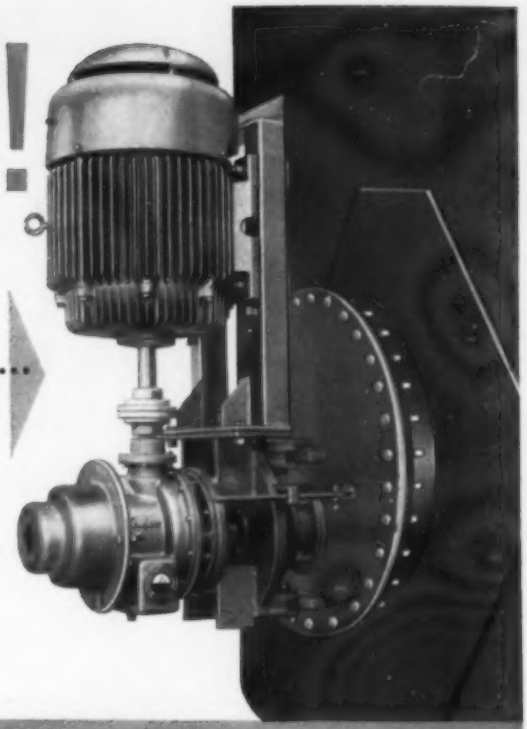
Brown & Root, Inc., has been awarded contract for construction of two major offshore pipe line projects in the Arabian Gulf. The larger construction task will consist of two 32-inch submarine products lines extending from near Fao, Iraq, to a huge new loading dock located 25 miles at sea where supertankers can dock and pickup cargo. Completion on the Iraq Petroleum Company work is expected by September.

Brown & Root will then construct a 30-mile, 18-inch crude in the Gulf. Abu Dhabi Marine Areas Ltd.'s, line

Sea-going tug, Elbe, picks up Minor at Gulfport, Miss.

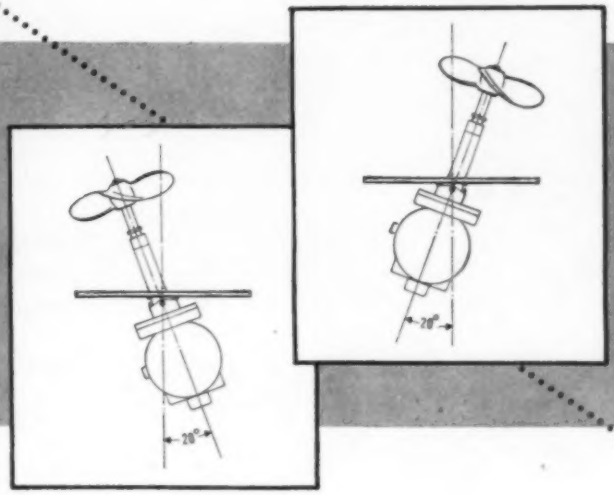
BOTTOMS UP!

JENSEN Mixers provide a method of sweeping crude tank bottoms, thoroughly and economically, regardless of tank conditions, size, or location.



ELECTRIC-POWERED VARI-ANGLE MIXER

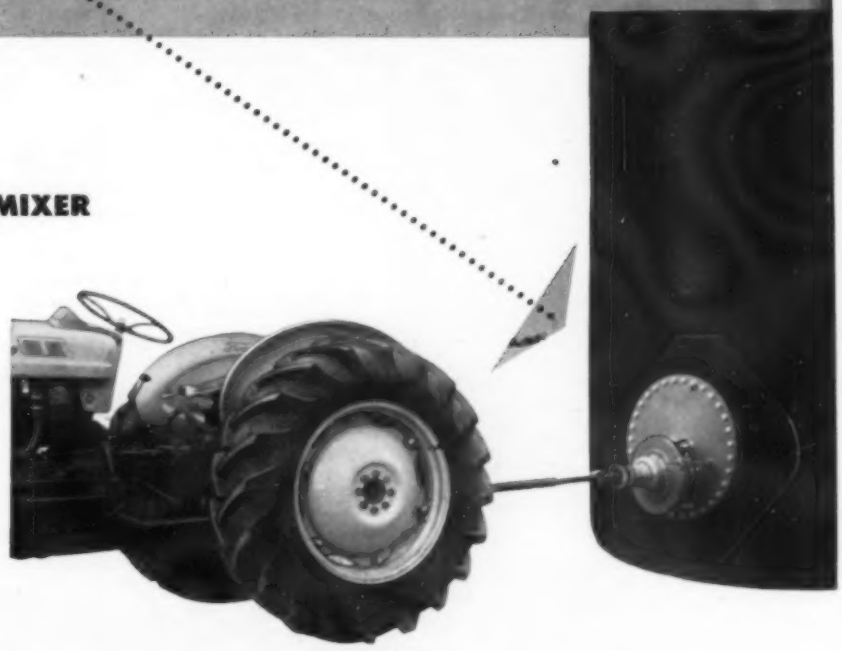
- Light Weight
- Compact with little overhang
- Electric powered for 500 to 200,000 barrel tanks
- Jensen Vari-Angle feature



Jensen Vari-Angle Mixer is adjustable, even during operation. The mixer produces a directed flow stream by varying the angle of the mixer 20° on either side or a total sweeping action of 40°. This complete sweep prevents bottom settling and removes accumulated deposits—HENCE BOTTOMS UP.

DIESEL-POWERED VARI-ANGLE MIXER

- Standard Tractor
- Standard Tractor PTO
- Diesel powered for 500 to 200,000 barrel tanks
- Jensen Vari-Angle feature



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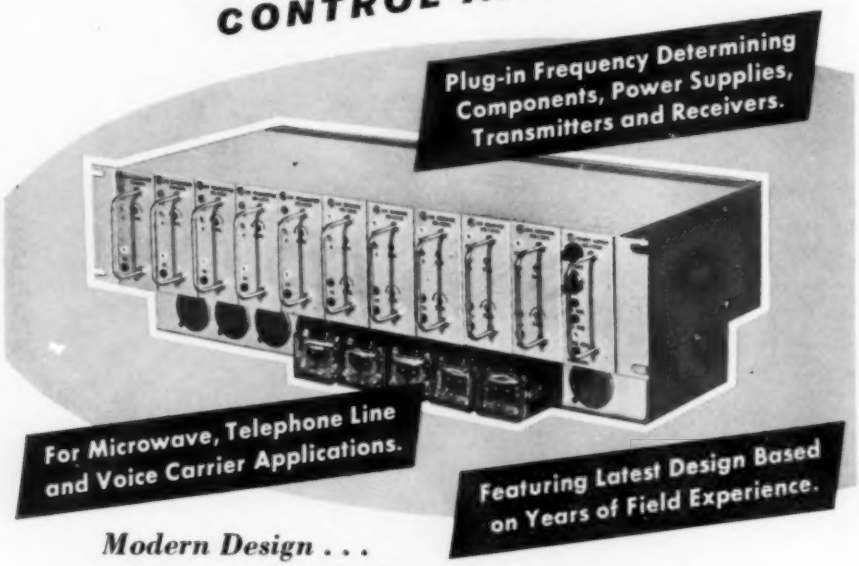
Newest RFL Transistorized Series 2056

AM and FS Tones

for TELEMETERING and CONTROL APPLICATIONS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Modern Design . . .
10 Transmitters or Receivers
and Power Supply in One Single Frame.

The 2056 Series of Audio tones features modern design utilizing plug-in card construction and provides equipment at a very minimum in cost with a maximum number of channels in a given space. For example, 10 AM transmitters or receivers and a common power supply are mounted in a single 3½ x 19" frame. Each channel is conveniently terminated with a terminal strip at the rear of the frame. Output relays are mounted on a bracket attached underneath the main chassis frame, each relay being located directly under its respective channel.

The channel frequency determining components are also of the plug-in type and are mounted directly on the channel plug-in assembly in AM units, and adjacent to plug-in assemblies on FS units. This type of design, of course, keeps spare parts requirements to a minimum, since all plug-in cards are common to all frequencies.

The 2056 Series of AM tones were designed to meet low speed tone signalling and control requirements when low noise lines and inherently low noise communication circuits as provided by microwave and voice carrier equipments are available for transmission.

The 2056 Series of FS tones are used when ultimate reliability and high speed keying is required. They can be used in circuits which are inherently noisy and which are subject to fading conditions.

The FS tones are available with either TWO or THREE frequency outputs. The former being employed in normal signalling and control circuits, whereas the latter is used in two-function single channel applications such as RAISE-OFF-LOWER, FORWARD-OFF-REVERSE.

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CALIFORNIA
Luscombe Engr., Pasadena, Calif.

ORE., WASH.
Hawthorne Electronics, Seattle, Wash.

CANADA
Microwave Sys., Scarborough, Ont.

FOREIGN
Telesco International, New York

SEND FOR TECH. DATA — For additional information, including application data, write or phone DE 4-3100. Demonstrations available by local representatives.

RFL Radio Frequency LABORATORIES, INC. Boonton, New Jersey, U.S.A.

will extend from Umm Shaif offshore oilfield to Das Island in the Arabian Gulf. Abu Dhabi Marine Areas Ltd., is owned by British Petroleum Co. and Compagnie Francaise Des Petroles.

The L. E. Minor, Brown & Root's large lay-barge, will lay the offshore lines. The Minor and M-209 barges left Houston's port late last month on a 100-day, 10,000-mile ocean trip to the Arabian Gulf. The barges are loaded with all pipe laying equipment and necessary supplies for a 160-man crew.

Pipe line operations will be under supervision of superintendent Bill Plake. Hugh C. Jackson, captain of the Minor, will direct the long journey across the Atlantic, Mediterranean, through the Suez Canal, through the Red Sea and up the Arabian Gulf to Fao, Iraq. Gibraltar will be the first refueling stop after 5,168 miles at sea. A sea-going tug, the Elbe, will tow the barges from Gulfport, Miss., to the Arabian Gulf.

Tennessee California Files Application with Commission

Tennessee California Transmission Company, which proposes to build the 105-mile, 24-inch Texas link in the Texas-Mexico-California gas line, has filed with the Federal Power Commission asking the commission to disclaim jurisdiction over the Texas portion of the $225-million project.

Should the FPC determine the pipe line subject to its jurisdiction, the company requested a certificate of public convenience and necessity to construct and operate the line.

All of Tennessee California's facilities would be in Texas. The company will not make sales of gas for resale in interstate commerce nor transport gas in interstate commerce. The $12-million Texas line would run from Humble Oil & Refining Company's King Ranch gas plant to the Texas-Mexico border near Reynosa. Sixty-nine miles of 12-inch and smaller laterals would connect the main line with other South Texas gas fields. Design capacity would be 380 MMcf.

Hearings before the California Public Utilities Commission will be resumed March 15. The PUC has been been requested to authorize Southern California Edison Company to import gas from Mexico into California and to permit California Gas

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Teamwork is essential to success in baseball. For the most successful performance, the various piston rings on any particular piston also must work together as a "team." Properly selected, the best combination of rings will control blow-by, lubricate effectively without oil waste, seal compression and provide full power and long life.

This kind of piston-ring "team work" is what you get when you use Pedrick Engineered Sets. Backed by 40 years' experience in engineering correct combinations of rings for particular engines, Pedrick Engineered Sets, in single-cylinder units for big-bore engines, offer the very best performance which can be obtained with the very latest development in ring designs. Engineered Sets also simplify handling, ordering and inventory.

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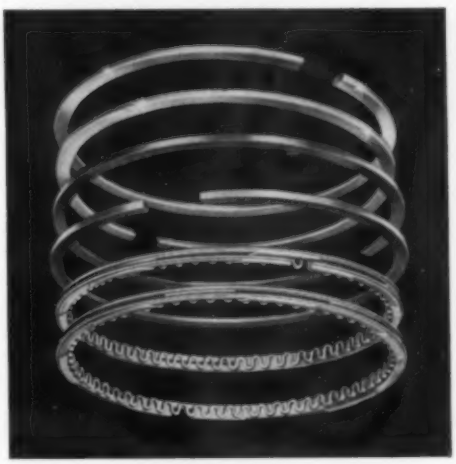
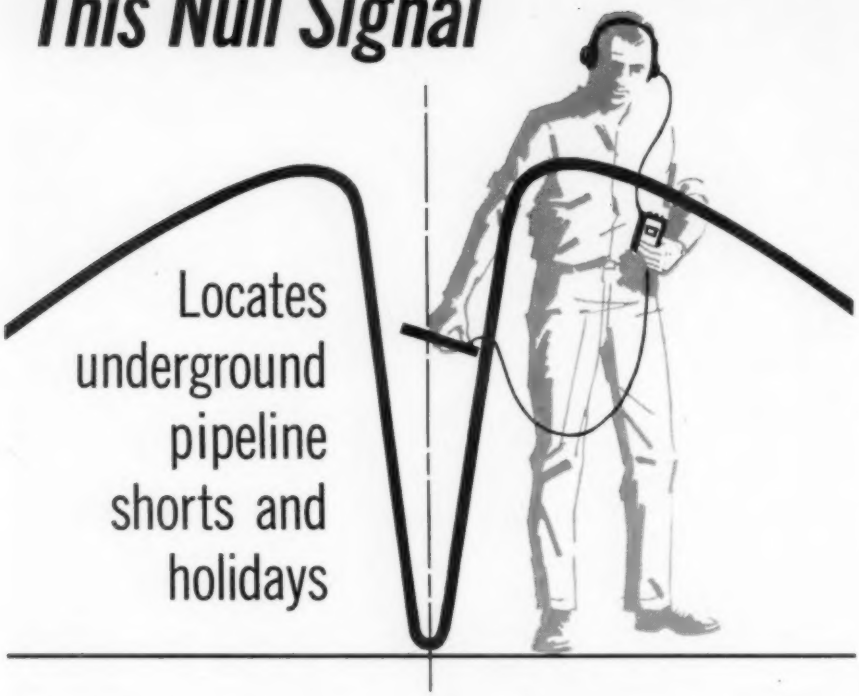


A "Team" of Pedrick Rings... An Engineered Set For a Large Diameter Engine.

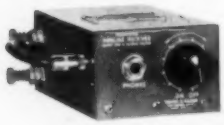
Pedrick PISTON RINGS

PEDRICK PIONEERED *Conformable* RINGS IN ENGINEERED SETS FOR BIG-BORE ENGINES

This Null Signal



Locates underground pipeline shorts and holidays



The null search system, teamed with Tinker and Rasor all-transistorized, Pearson-type Detectors, has greatly simplified the location of electrical shorts and holidays in underground pipe coatings. Findings are made within inches because the null is a positive factor which is either present or not present.

The Tinker and Rasor Underground Detector employs a transistorized oscillator which generates a 15 watt, 750 cycle, stable A.C. audio-frequency signal. Two 750 cycle resonate filters in the receiver reject unwanted signals. Using a low impedance search coil, one man can inspect a buried line at a rapid walk. Shorts will be indicated sharply and surely. A two man team is equally effective in locating holidays.

Tinker and Rasor has prepared a complete data kit which describes the null search system as well as other recommended procedures for inspecting protective coatings. Material includes technical data on equipment, general discussion of types of detectors, theory of operation, etc.

Engineering Note:
To insure a perfect application, include Tinker & Rasor Holiday Inspection. Write for specification guide.

Quality Control for Coating Application

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Transmission Company to build the necessary facilities to transport gas from near Mexicali to Los Angeles. Applications for export-import permits and presidential permits are on file with the FPC.

Standard Oil Company (Ind.) To Build By-Products Line

Standard Oil Company (Ind.) has joined with Pembina Pipe Line, Ltd., in its proposal to construct a by-products pipe line from Alberta, Can., to the Chicago area.

Standard announced that the companies would cooperate in design, finance, construction and operation of the common carrier which would handle propane, butane and condensate. The plans include a gathering system in the Alberta foothills area to transport the liquids for Canadian needs and for export into the United States. Pembina has been promoting the line for over a year. A subsidiary, Westalta Products Pipe Line, Ltd., has applied with the Alberta Conservation Board for permission to construct the gathering lines. Another Pembina affilate, Foothills Pipe Lines, Ltd., has planned to lay the 1,300-mile line from Alberta to Chicago.

Several proposals are competing with these plans. Provincial Products Pipe Lines, Ltd., Hydrocarbons Pipeline, Ltd., and Hudson's Bay Oil & Gas Co., Ltd., all proposed to lay gathering lines which could deliver products to existing crude lines for export to the United States.

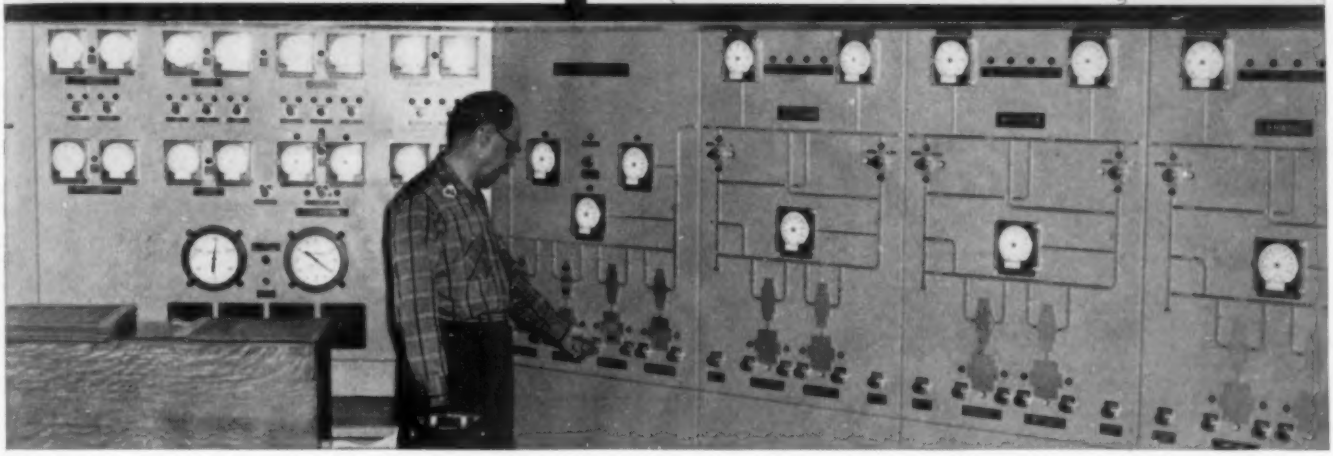
Standard's subsidiary, Tuloma Gas Products Company, would purchase the liquids from Alberta producers on a 20-year basis. In addition to the Alberta Conservation Board approval, the companies will need other Canadian and United States government approvals for export and import.

Texas Eastern Plans $83 Million Expansion

Texas Eastern Transmission Corporation has filed an application with the Federal Power Commission seeking permission for construction of 474 miles of pipe lines and 97,300 compressor horsepower.

The expansion program is designed for a two-year period with the majority of the work scheduled for the initial stage. If FPC approval is granted, Texas Eastern would lay 330 miles of gas lines and install

Miniature Bristol Metameter* telemeters on panel at Corsicana station of Magnolia Pipe Line Company. Instruments at right (in front of engineer) monitor new 20" pipe line at Corsicana, Grapeland, Groveton, and Bragg, Texas. Additional Bristol instruments (behind engineer) monitor locally the 20" pipe line to Lima, Ohio, and Magnolia's LPG facilities. (See map.)



Bristol Telemetering aids in remote operation of Magnolia Pipe Line Company's new Beaumont-to-Corsicana pipe line

...allows close control over pipe-line pressures at stations 62, 108, and 159 miles from Corsicana operating station

Rapid and continually growing demand has necessitated periodic increases in Magnolia Pipe Line Company's already extensive crude-oil pipe line facilities.

Latest addition is 204-mile, 20-inch pipe line from Corsicana to Beaumont, Texas, boosting crude capacity supplied to Beaumont refineries from 175,000 to 240,000 barrels per day—a 37% increase.

A big feature of the new Corsicana-to-Beaumont pipe line is a Bristol Metameter Telemetering system. This system transmits vital pressure information to the central operating station at Corsicana and aids in remote operation from Corsicana of stations at Grapeland, Groveton, and Bragg (62, 108, and 159 miles away, respectively). Magnolia Pipe Line Company designs its telemetering to give close control over pipe line pressures, and this is particularly important since crude is an incompressible fluid. This is the tenth Bristol telemetering system in operation on Magnolia's extensive pipe line network. Others are Midland tank farm to office; Keller to Ringgold; Corsicana tank farm and station to office; Waelder, Schulenburg, and Columbus to Luling; Hull to Houston; Mont Belvieu to Houston; Texas City to Houston; Waskom and Center to Beaumont; and Orange to Beaumont. (See map.)

This is just one of the Bristol telemetering systems in use today on natural-gas and crude-oil products pipe lines, electrical transmission networks, water plants and distribution systems, and steel mills and other industrial plants. Pressure, liquid level, flow (including total corrected flow), temperature, mechanical motion, voltage, current, and power are among the many variables that can be transmitted any distance, from a few yards to hundreds of miles. Almost any transmission medium may be used: telephone lines, carrier current, microwave, VHF or UHF radio. For full data, write: The Bristol Company, 114 Bristol Road, Waterbury 20, Conn., a Subsidiary of American Chain & Cable Company, Inc.

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51,000 horsepower this year to increase the system's capacity 108.8 MMcf of gas daily at a cost of $55.2 million.

The second stage, planned for 1962, includes 144 miles of pipe line and 46,300 additional horsepower at a cost of $27.8 million. This would raise the company's capacity another 116.2 MMcf of gas per day.

This year's work calls for a 165-mile, 20-inch line from West Monroe, La., to Kosciusko, Miss., approximately 128 miles of 30-inch loops between Kosciusko and Lambertville, N.J., and 37 miles of new laterals in New Jersey. The 51,000 hp will be installed in four new stations at West Monroe, Kosciusko, Danville, Ky., and Delmont, Pa., and at existing stations in Gladeville, Tenn., Wheelersburg, Berne, Lebanon and Circleville, Ohio, and Wind Ridge, Pa.

Continental Files For Crude Gathering System

Continental Pipe Line Company has applied with the Wyoming Public Service Commission for permission to construct a crude gathering system and an 18- mile line in Wyoming. The system would be laid within the Bertha oil field area in Campbell County and the Prairie Creek oil field area in Campbell and Crook counties. Also an 18-mile, 4-inch line will connect these fields with Miller Creek station of Belle Fousche Pipeline Company.

Westcoast Transmission To Build Crude System

The British Columbia government has awarded a permit to Westcoast Transmission Company to construct a 500-mile, 12-inch crude line in British Columbia.

The line will parallel Westcoast's gas line extending from Taylor to Kamloops. It will be designed for a 75,000 bpd capacity. Westcoast's proposal for the $30 million line won out over three other plans—Trans-Prairie Pipelines Ltd., Peace River Oil Company Ltd., and Trans Mountain Oil Pipe Line Co.

Westcoast will deliver crude to Trans Mountain at Kamloops, but by one of the conditions of the permit Westcoast would have to extend the line to Vancouver at any time upon request of provincial government.

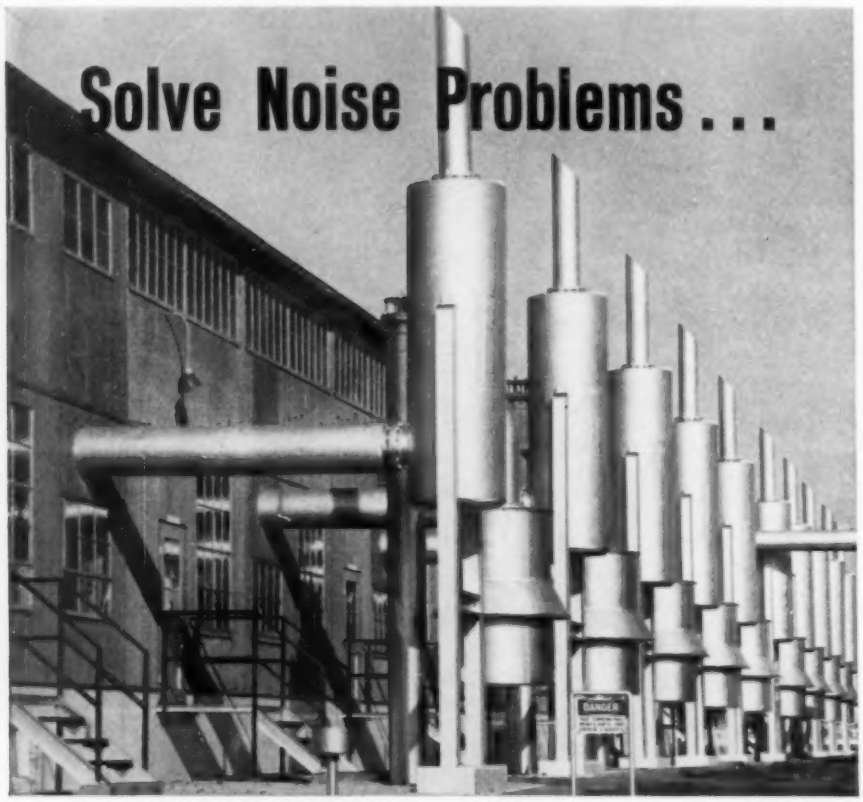
Although the Westcoast project was the longest line proposed, it had several advantages. The right of way already exists and construction can be completed within the year. Also the Taylor-Kamloops route passes many settled areas which may become refining centers in the future.

Phillips Pipe Line to Lay 160 Miles of Crude Lines

Phillips Pipe Line Company will construct 75 miles of main line and 85 miles of gathering lines to carry crude oil and condensate from the Camrick field near Gray, Okla., to a refinery at Phillips, Texas. The line, which will be completed within six months, will serve several intermediate fields also.

Tennessee Gas Buys West Bastian Reserves

Tennessee Gas Transmission Company has purchased for over $150 million the oil and gas producing properties in the West Bastian Bay field of Plaquemines Parish, La., from Pan American Petroleum Corporation. Pan American has transferred its oil



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Rear view of a Multiplexer-Demultiplexer Shelf, Type 250 Model 1, showing 2 Transistorized Power Suppliers and Changeover Relay.

New ALL-TRANSISTOR

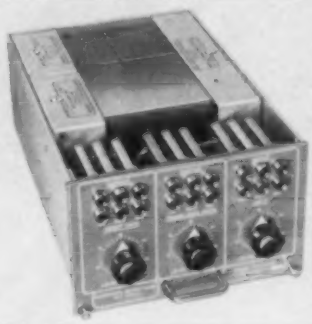
NORTHERN RADIO MULTIPLEXER and DEMULTIPLEXER

Type 248 Model 1 Type 249 Model 1

The new Multiplexer, Type 248 Model 1 (functional replacement for Multiplexer TD97-FTG-2), and Demultiplexer, Type 249 Model 1 (functional replacement for Demultiplexer TD98-FGR-3) are intended for use with twin-channel, single-sideband radio circuits operating in the high-frequency range. Their purpose is to derive two voice-frequency circuits from each of the radio channels. By means of frequency division multiplexing, the radio bandwidth from 200 to 6000 cps is divided into two transmission circuits, each with a bandwidth from 375 to 3025 cps. Four such vf circuits are derived from the twin-channel radio, and these are used to transmit carrier telegraph signals or to provide telephone or facsimile service.

The Multiplexer and Demultiplexer are designed to slide into the Northern Radio Type 250 Model 1 Shelf, which accommodates two each Multiplexers or Demultiplexers, or one each Multiplexer and Demultiplexer.

Two Multiplexers, Type 248 Model 1, are required for full utilization of the capacity of a radio transmitter. One is used to transmit telegraph, telephone, or facsimile signals from two vf circuits to the radio channel designated as sideband A. The second Multiplexer performs the same function for sideband B. In this way four vf circuits are applied to the twin-channel radio transmitter.



Two Demultiplexers, Type 249 Model 1, are required for full utilization of the capacity of a radio receiver. One is used to receive telegraph, telephone, or facsimile signals for two vf circuits from the radio channel designated as sideband A. The second Demultiplexer performs the same function for sideband B. In this way four vf circuits are derived from the twin-channel radio receiver.

The Multiplexer and Demultiplexer are transistorized equipments, including necessary bandpass filters, line amplifiers, carrier frequency sources, modulators and attenuators. The Multiplexer requires a nominal 14 volts DC at 125 milliamperes; the Demultiplexer, approximately 200 milliamperes at the same voltage. The power supply is normally provided from the Northern Radio Power Supply, Type 223 Model 1, which is plugged into the rear of the Type 250 Model 1 Shelf.

WRITE ON YOUR LETTERHEAD FOR FURTHER INFORMATION TO DEPT. PL-3

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Looping through Coosa — and Tallapoosa, too

As many Alabamans know, Coosa and Tallapoosa counties are on the route of Transcontinental Gas Pipe Line Corporation's Brownsville-to-New York City trunk main.

And right at the border of the two counties is where our photographer "shot" the 36-in.-OD Bethlehem Line Pipe you see here.

The Sharman, Allen, Gay & Taylor spread is one of a number of main-line loops in Transco's current program, which totals over 200 miles of line in Louisiana, Mississippi, Alabama, Georgia, and South Carolina.

Bethlehem supplied 36-in. pipe (.406 and .469 in. walls) for installation in all those states. It was epoxy-lined at our Steelton, Pa., pipe mill.

LINE PIPE TO 42 IN.—Big as the Transco pipe is, it isn't the largest made by Bethlehem. We can produce it to 42 in. OD—and with ¾-in. walls! It's electric fusion-welded, and hydraulically expanded.

ERW PIPE TO 16 IN.—At Sparrows Point, Md., we produce electric resistance-weld pipe from 5⁹⁄₁₆ in. through 16 in. OD, and in lengths to 62 ft. We also produce continuous buttweld pipe from ½ in. through 4½ in. OD. Of course, all sizes of Bethlehem line pipe conform strictly to appropriate API 5L or 5LX specifications.

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and gas rights down to the base of presently known producing formations and all well and lease production equipment to TGT.

It is estimated that over a trillion cubic feet of natural gas reserves exist in the field. Involved in the sale are 10 leases, with 11 gas and 13 oil wells, in which Pan American held 100 percent working interest, and three joint interest leases with one oil and two gas wells.

Pacific Gas Transmission Lets River Crossing Contract

Pacific Gas Transmission Company has awarded a contract to Missouri Valley Dredging Company for construction of a crossing of the Snake River in Washington. The 36-inch crossing is part of the 1,400-mile, gas line from Alberta to California.

The river crossing site is 40 miles northeast of Pasco, Wash., about 1½ miles upstream from the confluence of the Snake and Palouse rivers. The crossing will be 1,700 feet wide and most of the river bed is solid rock, the banks are steep and railway lines run along both banks. Missouri also will install the pipe through casings beneath the railway tracks on each side of the river.

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Alamo Gas Supply Co. Plans 291-Mile System

Contracts have been let by Alamo Gas Supply Company for construction of its planned 291-mile, 14-24-inch gas system to serve San Antonio, Texas. O. R. Burden Construction Corporation will build the system which would deliver gas from southwest Texas to San Antonio. Construction is scheduled to start in the spring.

Alamo Gas Supply's officers include Glen A. Martin, president; I. E. Burnham, vice president, and John H. Emerson, manager of operations. Alamo has a contract to serve San Antonio a 20-year gas supply.

Buckeye Pipe Line Plans Product System Expansion

Buckeye Pipe Line Company plans to construct 42 miles of 8-inch products line to extend its Midwest products system from Flint to Bay City, Mich. Buckeye's Midwest system includes over 1,300 miles of lines presently and the $1.7 million expansion will serve the growing Bay City area.

French Crude Line In Sahara Planned

Soc. Nationale des Petroles D'Aquitaine plans to lay a 75-mile, 10-inch crude line to connect the El Gassi-El Agreb oil field to the Hassi Messaoud field in Algeri.

This will tie the El Gassi-El Agreb field with the oil line from Messaoud to the Mediterranean coast at Bougie.

International Gas Co. Considering Mexican Line

Another gas pipe line from Mexico to deliver gas to California is being considered by International Gas Co.

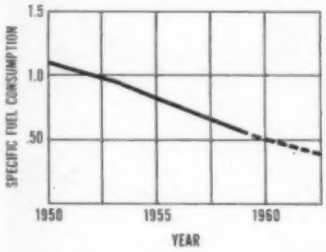
The line would supply 100 MMcf of gas daily to cities in Mexico, and some 500 MMcf of gas per day to the Los Angeles area.

Small gas turbines soon to surpass piston engines for competitive applications

by Herbert Kunzel, President
Solar Aircraft Company
A Subsidiary of International Harvester Company

The gas turbine engine has made news this year as it has expanded into new and broader applications in the prime mover field. Behind this advance is continuing improvement in design and production. Even more advanced gas turbines will be developed in the next few years. In the small engine class (under 1000 hp) gas turbines will soon surpass overall piston engine performance and cost for competitive applications. They will also retain the inherent advantages of the gas turbine over the reciprocating engine.

One of the major reasons for this prediction is an impressive improvement in gas turbine economy. Previously, fuel consumption and high initial cost have kept the turbine out of all but selected power assignments. Industry and the military both thought the engines too expensive for most applications.



Through constant improvement, however, Solar has been steadily bringing simple cycle, small turbine specific fuel consumption down to an area competitive with piston engines. The fuel consumption of Solar's early 50 hp engines in 1948, for instance, was about 2.25 lb/hp-hr. The 1100 hp Saturn engine, which went into production this year, has the excellent simple-cycle fuel consumption of only .63 lb/hp-hr. Solar's experienced engineers improve life, "producibility," and performance characteristics with each new engine. At the same time, production costs are lowering rapidly.

Another significant advance in Solar turbine development has been the evolution of a unique design philosophy. Most gas turbines fall into one of two extreme categories: 1) Lightweight, high horsepower aircraft turbines, built to be as light as possible (about ¼ to ½ lb/hp), and 2) conventional industrial engines designed along the lines of steam turbines with a ratio of about 10 lb/hp. Both have inherent disadvantages. The aircraft turbines are relatively delicate with consequent problems of frequent overhaul and short life. Massive engine design, on the other hand, involves unnecessary bulk and difficulties with thermal lag and distortion. In either case, inherent advantages of the gas turbine engine are diminished and initial cost is adversely affected.

Solar's approach has been to develop a family of gas turbines that have both long life and light weight. The Saturn engine, with a weight-to-power ratio of 1.1 lb/hp, is heavier and more rugged than aircraft engines but much lighter than the usual industrial gas turbine. Although it is designed for long life, it has no more materials than are necessary to satisfy structural and thermal requirements.

Promising even further improvements in the turbine engine is the combination of Solar with International Harvester Company this year. IH saw the advantage of more power per pound several years ago. Their research and development has stressed performance and much work has been done by them on regenerative cycle turbines to reduce fuel consumption.

To basic research, they have added their many years of experience and leadership in high performance and low cost through efficient production of many thousands of IH engines for trucks, construction equipment and farm machinery.

Solar's successful Saturn engine development team and the combined research and resources of the two firms are now focused on further engine development in the area below 1100 hp. Preliminary design for a turbine in this range indicates that the following standards are feasible:

1. A life cycle equal to or better than conventional diesel engines—with considerably less maintenance.
2. Fuel consumption in the .4 to .5 lb/hp-hr range.
3. Cost competitive to conventional reciprocating engines.
4. Inherent ease of starting and operation in a wide variety of climatic conditions.
5. Small size and light weight.

Developments like these are certain to continue the increase in turbine applications and use.

For additional information write to Dept. H-215, Solar Aircraft Company, San Diego 12, California.

Saturn engine powering oil well fracturing unit

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1956 INSTALLATION, Chester to Bellwood, Va., 4.5 miles of 6" pipe

1960 INSTALLATION, Boswell's Tavern to Gum Spring, Va., 26.7 miles of 18" pipe

Commonwealth Natural Gas makes repeated use of Polyken® tape on strength of past performance

Officials of Commonwealth Natural Gas Corporation of Richmond, Va., were impressed in 1956 with the many advantages of Polyken protection. With confidence based on the cathodic protection needs of their Polyken tape-coated 1956 Bellwood line (*inset photo*), they put this coating to work two years later on their Chester to Petersburg, Va., line (12 miles of 18" pipe). In 1959, *more* Polyken coating . . . Waverly to Ivor, Va., (15.8 miles of 12" pipe). And most recently, the line from Boswell's Tavern to Gum Spring (*main illus.*).

It stands to reason that repeated use is founded on first-hand satisfaction and trust. Many discriminating companies make Polyken protection their standard specification because of its dependable performance. Get full details on Polyken performance and economy from your representative, or write Polyken Sales Division, 309 West Jackson Boulevard, Chicago 6, Illinois.

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Tulsa, Oklahoma
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PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U.S.

Alamo Gas Supply Co., San Antonio, 291 miles, 14-24-inch, gas, Southwest Texas to San Antonio, Texas, contract let to **O. R. Burden Construction Corp.**

Algonquin Gas Transmission Co., Boston, 25 miles, 20-inch; 8 miles, 8-inch, gas, and 12,000 hp addition in Massachusetts, $6 million, approval FPC.

Arkansas Louisiana Gas Company, Shreveport, La., 58 miles, 2-6-inch, gas, planned.

Belle Fourche Pipeline Co., Casper, Wyo., 103 miles, 8-inch, crude, Fiddler Creek field to Lance Creek, Wyo., and branch lines from North Donkey Creek field to Rozet and Miller Creek fields, $2¾ million, approved by Wyoming Public Service Commission.

Border Gas Transmission Company, 300 to 400 miles, gas, gathering, in South Texas, $10 million, planned.

Buckeye Pipe Line Co., New York, 42 miles, 8-inch, products, Flint to Bay City, Mich., $1.7 million, planned.

California Gas Transmission Company, Los Angeles, (subsidiary of Tennessee Gas Transmission Company), 292 miles, 20-34-inch gas, from Mexico-California border near Mexicali, to Los Angeles and 10,000 hp. to tie into Texas Mexico-California line, $50 million, before FPC and California Public Utilities Commission.

Coastal States Gas Producing Co., Corpus Christi, Texas, 60 miles, 10-inch, gas, gathering, La Salle and Frio counties, Texas, before FPC.

60 miles, small diameter, gas gathering line, to tie in with system under construction and extend to Pearsall County, Texas, planned.

Coastal Transmission Corp., Houston, 81 miles, 3 to 10-inch, gas, laterals; 5,500 hp in stations at Port Lavaca, Texas, and Eunice, La., and additional 1,500 hp at Robstown, Texas, $6.2 million, FPC authorization.

Colorado Interstate Gas Co., Colorado Springs, 140 miles, 34-inch, gas, Green River, Wyo.,-to-Provo, Utah; 109 miles, 26-inch, Texas Panhandle to southeastern Colorado, 136 miles, 34-inch, southeastern Colorado-to-Pueblo, Colo.; 107 miles, 30-inch, Pueblo-to-Denver, $91 million, FPC conditional authorization.

Colorado Oil & Gas Corp., Denver, 400-miles, gas, from Gubik field to Fairbanks, Alaska, planned.

Columbia Gulf Transmission Company, Houston, 97 miles, 30-inch, loops in Kentucky, Tennessee, Mississippi and Louisiana; 29 miles, 12-inch lateral in Louisiana, $15 million, before FPC.

El Paso Gas Supply Company, El Paso, Texas, 228 miles, 30-inch, gas, main, Live Oak to Sutton County, Texas, $30 million, before FPC.

El Paso Natural Gas Company, El Paso, 199 miles, 30-inch, Permian-San Juan crossover loop, before FPC.

17 miles, from Pacific Gas Transmission Co. facilities to near Spokane, Wash., before FPC.

34 miles, 20-inch, Puckett to Goldsmith, before FPC.

23 miles, 20-inch, Goldsmith to Eunice-Plains line, before FPC.

9 miles, 20-inch, Goldsmith-Plains loop, before FPC.

43,600 hp in new and existing stations in Texas, Oklahoma, New Mexico and Utah, before FPC.

400 miles, 34-inch, Salt Lake City, Utah, to California border, FPC conditional authorization.

El Paso Natural Gas Products Company and El Paso Products Pipeline Co., 32 miles, 6-inch, crude, from Patrick Draw Oil and Gas Field to Wamsutter, Sweetwater County, Wyoming, before Public Service Commission.

Equitable Gas Company, Pittsburgh, Pa., 31 miles, 16-inch, and 26 miles, 20-inch, in West Virginia and Pennsylvania, $5 million, before FPC.

Hope Natural Gas Company, Clarksburg, W. Va., 20 miles, 20-inch, gas, in Lewis, Ritchie and Pleasants counties, W. Va., $2 million, FPC authorization.

Houston Texas Gas & Oil Corp., St. Petersburg, Fla., 199 miles, 2 to 6-inch, gas, laterals; 20,000 hp in five new stations; $12 million, FPC examiner authorization.

Kansas-Nebraska Natural Gas Company, Hastings, Neb., 165 miles, 2-8-inch, gas, extension from Alliance, Neb., to Chadron, Crawford, Hemingford, Hay Springs, Gordon and Rushville, Neb., before FPC.

45 miles, 2-3-inch, gas, in Kansas, approved by Kansas Corporation Commission.

2,000 hp addition at Scott City, Kan., FPC approval authorization.

2,500 hp addition at Holcomb, Kan., before FPC.

Lone Star Gas Company, Dallas, 52 miles, 18-inch, Springtown to Gordon, Texas, planned.

47 miles, gathering lines in Palo Pinto, Erath and Stephens counties, Texas, planned.

Continued on Page 76

For more data on advertised products, use Readers' Service Cards, last page.

PROPOSED CONSTRUCTION

continued

Long Island Pipeline Company, New York, 75 miles, 20-inch, products, Linden, N. J., to Long Island, N. Y., $30 million, planned.

Lo-Vaca Gathering Co., 230 miles, 6-20-inch, gas, gathering, Live Oak to Lavaca County, Texas, planned.

Matador Pipe Line Corp., Denver. 175 miles, crude, from Bottineau, Burke and Renville counties, N. D., to Cromer, Man., Canada, $4 million, proposed.

Michigan Wisconsin Pipe Line Co., Detroit.

37 miles, 6 and 12-inch lateral loops in Wisconsin, before FPC.

29 miles, 30-inch, loops, Illinois, Indiana, and Michigan, 3,000 hp. station, Janesville, Wis., before FPC.

Two 2,000 hp units at Meade, Kansas; one 2,000 hp unit at Havensville, Kansas, before FPC.

Mid-America Pipe Line Co., 405 miles, 10-inch, LPG, Superior, Wis., to Chicago, $12 million, considered.

Natural Gas Pipeline Company, Chicago, 62 miles, gas, pipe line and various river crossings, FPC authorization.

257 miles, 30-inch, gas, loops, $28 million, before FPC.

89 miles, gas, loops, planned.

New Haven Pipeline, Inc., products line, New Haven, Conn. to Springfield, Mass., $2.5 million, planned.

Niagara Mohawk Power Corp., 122 miles, 12-inch, Watertown and Massena, N. Y., contract let to Fulghum Contracting Corporation pending FPC approval.

Northern Natural Gas Company, Omaha, Neb., 236 miles, gas, in Kansas, Nebraska, Iowa, Illinois and Wisconsin and 14,050 hp, $25 million, before FPC.

124 miles, in Oklahoma, Kansas, Nebraska, Iowa, and Minnesota and 17,360 hp, $17 million, before FPC.

22 miles, in Iowa, $673,100, before FPC.

Northwestern Refining Co., crude gathering system, Rival and Lignite fields, North Dakota, $625,000, Public Service Commission approval.

Ohio Fuel Gas Co., 59 miles, gas, 4-24-inch main lines, in Belmont, Carroll, Cuyahoga, Fairfield, Logan, Lorain, Marion, Muskingum, Stark and Wayne counties, Ohio, $5.1 million, planned.

Panhandle Eastern Pipe Line Co., Kansas City, 305 miles, 30-inch, 40 miles, 26-inch, gas, loops, and 43,000 hp, and gathering facilities, $60 million, before FPC.

200 miles, 22-24-inch, gas, lateral, from Elk City, Okla., to Haven, Kan., before FPC.

Pan American Gas Company, Tulsa, 50 miles, 12-inch, gas, La Porte to Pasadena to Texas City, Texas, contract let on 32 miles to **Golightly Construction Co.**

Peoples Gas Light & Coke, Chicago, 29 miles, 36-inch, gas between North Shore and Calumet stations, planned.

Phillips Pipe Line Co., Bartlesville, Okla., 75 miles, main line, 85 miles, gathering crude, from Camrick field, Gray, Okla., to Phillips, Texas, planned.

Southern California and Southern Counties Gas Cos., Los Angeles, 93 miles, 34-inch, California-Nevada border to Newberry, Calif.

St. Lawrence Gas Company, Inc., Ogdensburg, N. Y., 75 miles, gas, main, United States-Canadian border to Ogdensburg, N. Y., $3.4 million, FPC examiner approval.

SunOlin Chemical Company, Philadelphia, 6,000 feet, ethylene line, under Delaware River, Claymont, Penn., to Penns Grove, N. J., $2 million, planned.

Tennessee California Gas Transmission Company, (subsidiary of Tennessee Gas Transmission Co.), 100 miles, 26-inch, gas, gas fields in South Texas to Texas-Mexico border near Reynosa, before FPC.

Tennessee Gas Pipeline Co., Houston 191 miles, 30 and 36-inch loops, in Ohio, Pennsylvania and New York, 72 miles of gathering lines and 43,600 hp in five stations, $46 million before FPC.

158 miles, 36-inch, gas, loops in Mississippi and Louisiana, FPC authorization.

21 miles, 16-inch, 2 miles, 12-inch, gas, Louisiana coast, Vermilion blocks 46 and 64, $3 million, before FPC.

50 miles, 10-16-inch, gas, offshore Louisiana, FPC authorization.

Texas Eastern Transmission Corp., Shreveport, La.

66 miles, 30-inch, gas, loops, between Vidor, Texas, and Lambertville, N. J., and 33,710 hp in four existing stations, $17.5 million, temporary FPC authorization.

165 miles, 20-inch, gas, West Monroe, La., to Kosciusko, Miss.; 128 miles, 30-inch, loops, between Kosciusko and Lambertville, N. J.; and 37 miles, laterals in New Jersey, 51,000 hp., $55.2 million, before FPC.

144 miles, gas, 46,300 hp. $27.8 million, for 1962, before FPC.

Texas Gas Transmission Corp., Owensboro, Ky., 96 miles, 26-30-inch, gas loops, Louisiana, Arkansas, Mississippi, Tennessee, Kentucky and Indiana; 50 miles, 8 and 16-inch extension into Terrebonne, La. producing area, $16.8 million, before FPC.

Transcontinental Gas Pipe Line Corporation, Houston.

211 miles, 36-inch, and 69 miles, 30-inch, loops and additional 32,040 hp, in Texas, Louisiana, Mississippi, Alabama, Georgia and South Carolina, $52 million, FPC examiner approval.

163 miles, 36-inch, gas, loops, in Louisiana, Alabama, Mississippi, Georgia, North and South Carolina, Virginia, Maryland and Pennsylvania, 10,500 hp, $30 million, before FPC.

13 miles, 24-inch and 18 miles, 20-inch loops, Louisiana, FPC authorization. 14 miles, 16-inch laterals, 1-mile, 12-inch lateral, Louisiana, $2.1 million, FPC authorization.

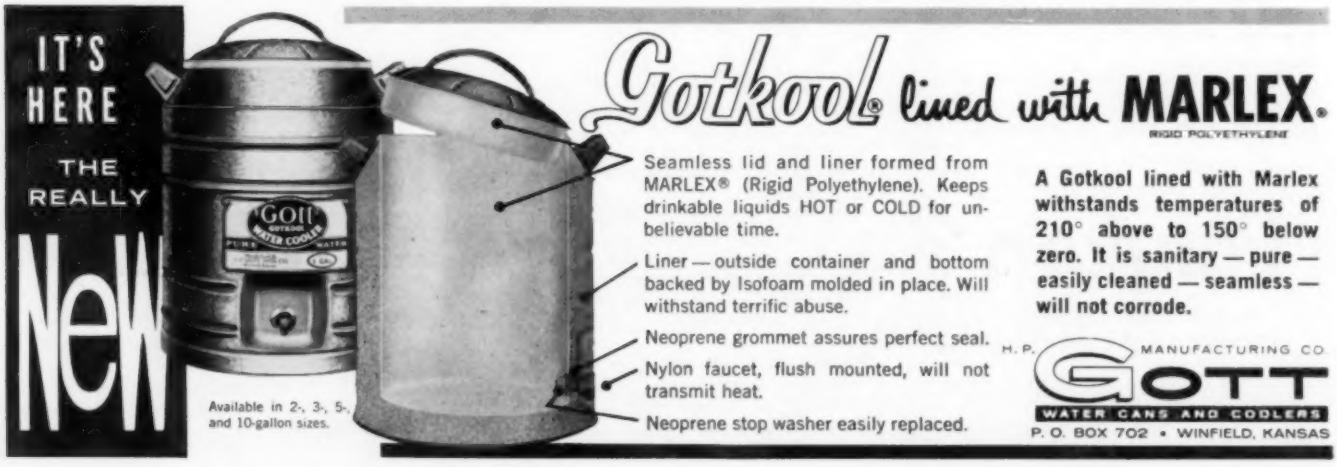
29 miles, 20-inch, gas, and 2,500 hp, in South Texas to take gas from South Texas Natural Gas Gathering Co., $2.4 million, FPC authorization.

Trans-Southern Pipeline Corp., Houston, 1,080 miles, 12-inch, LPG, from Mont Belvieu, Texas, to Danville, Va., and 215-mile spur line from Atlanta to Georgia-Florida border, $63 million, planned.

Trunkline Gas Company, Houston, 252 miles, 30-inch loops, and 140 miles, laterals, between Longville, La., and Tuscola, Ill., $45 million. Contracts let on 155 miles to Cape Construction, Western Pipe Line, Panama-Williams, Panama Inc., and Grayco.

United Gas Pipe Line Co., Shreveport, La., 59 miles, 36-inch, gas, lateral between Bastian Bay field and Plaquemines Parish, La., before FPC.

Continued on Page 78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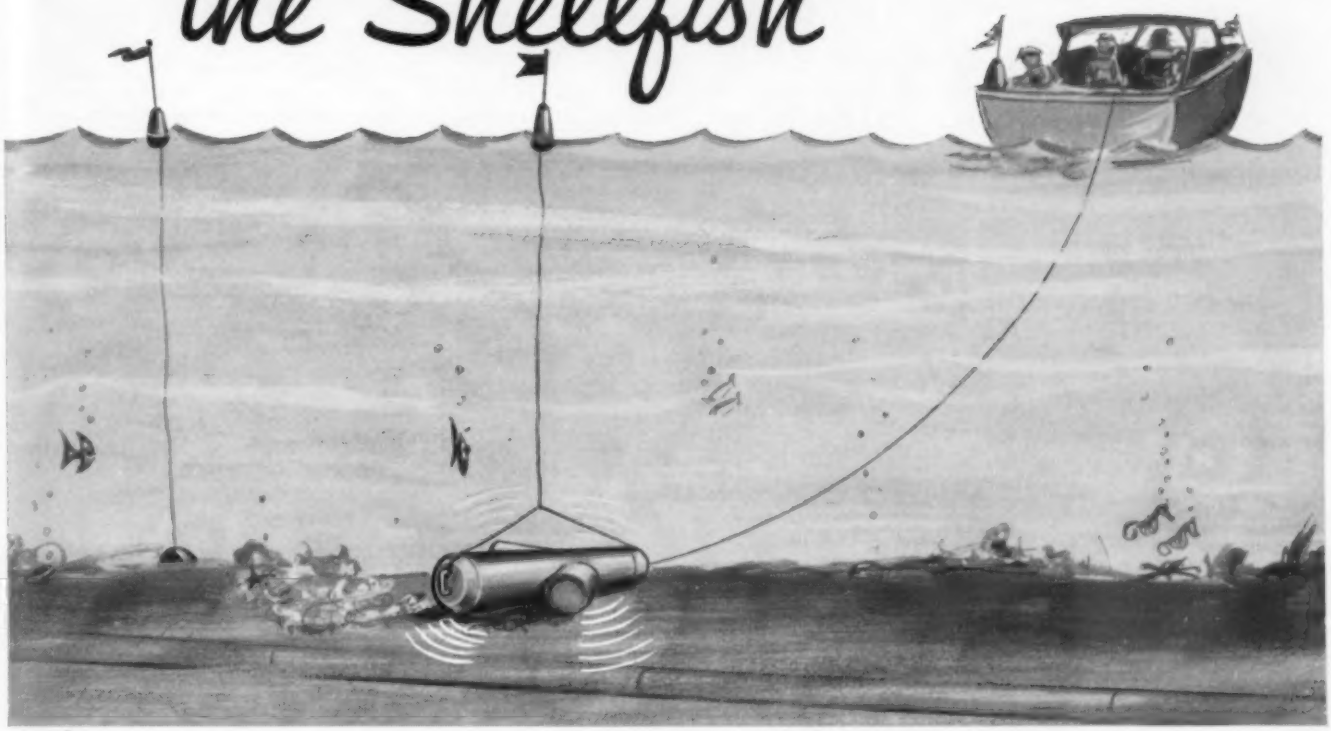

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PROPOSED CONSTRUCTION

continued

217 miles, 30-inch, gas, Lafayette to Monroe, La., planned.

Union Texas Natural Gas Corp., (joint project with Phillips Petroeum Co., Warren Petroleum Corp. and Tuloma Gas Products Co.) 1,000 miles, LPG, Houston to North Carolina, $35 million, planned.

Valley Gas Transmission, Inc., Houston, 55 miles, 3 to 8-inch, gas, gathering, in Hidalgo, Brooks, Starr and Jim Wells counties, Texas, $15 million, before FPC.

West Shore Pipe Line Co., 250 miles, 10-16-inch, products, East Chicago, Ind., to Green Bay, Wis., planned.

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella Coola, B. C., before B. C. Government.

Ajax Alberta Pipeline Ltd., 28 miles, 10-inch, gas, main, Morinville to Westlock, Alta., planned.

Assistencia de Oleodutos du Petrobras, Rio de Janeiro, 280 miles, 12-inch, crude, Rio de Janeiro to Belo Horizonte, Brazil, planned.

Abu Dhabi Marine Areas Ltd., (British Petroleum Co. and Compagnie Francaise Des Petroles) 20 miles, 18-inch, crude, from Umm Shaif offshore oilfield to Das Island, Persian Gulf, planned.

Barnabos Group (Italian Interests), crude line from Venice, Italy, to Insbruck, Austria, with extension to Munich, Germany, planned.

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

British American Oil Co., Ltd., Toronto, 125 miles, gas, Pincher Creek fields to Calgary, Alta., before Alberta Public Utilities Board.

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, India. Contract let on 250 miles to **Mannesmann-Saipem.**

Cartier Gas Corp. (St. Maurice Gas, Inc., and Consumers Gas Co., Toronto), 170 miles, gas, Montreal to Quebec City, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Foothills Pipe Lines Ltd., 1,300 miles, LPG, from Alberta-Saskatchewan border to Chicago, tie-in with Westalta Products Pipeline proposed system in Alberta, $100 million, before Alberta Board of Public Utilities Commissioners.

Gas del Estado, Buenos Aires, 1,050 miles, 30-inch, gas, Comodoro Rivadavia field to Buenos Aires, $380 million, bids submitted for design and construction by Texas Eastern Transmission Corp., ENI, and an Argentine firm.

Gas Trunk Line of British Columbia, Vancouver, 250 miles, 30-inch, gas, main, Fort Nelson to Taylor, B. C., planned.

Gases Naturales de Colombia, S.A., 140-mile, 10-inch, gas, Cicuco field to Barranquilla, Colombia, planned.

Hughenden Pipeline, 125 miles, products, Dick Lake gasoline plant to Hughenden Region, Alta., planned.

Hydrocarbons Pipeline, Ltd., Winnipeg, Manitoba, 880 miles, 6-8 inch, products, from Edmonton to Winnipeg, $35 million, partial authorization.

Independent Pipe Line Co., 2,019 miles, 34-36-inch, crude, Edmonton to Montreal, 23,000 pump horsepower, $395 million, before Borden Commission.

Interprovincial Pipe Line Company, 350-mile extension from Toronto to Montreal, looping line from Edmonton to Toronto, crude, $240 million, considered, products pipe line, Superior, Wis., to Chicago, considered.

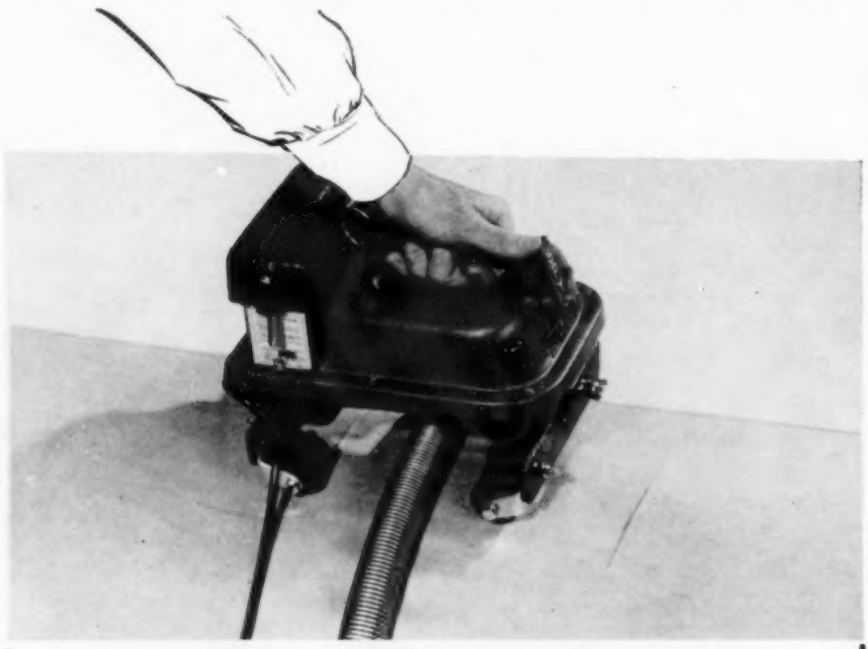
Mid-Continent Pipe Lines, Ltd., 1500-mile, 30-inch crude, Edmonton to Chicago, planned.

Naphtha Israel Oil Co., 75 miles, 6-inch, gas, Rosh-Zohar field to Ashdod Yam on Mediterranean planned.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

NIOGAS, 82 miles, 10-inch, gas, Traismauer to Amstetten, Austria, contract let to **Williams Brothers Company.**

Continued on Page 80



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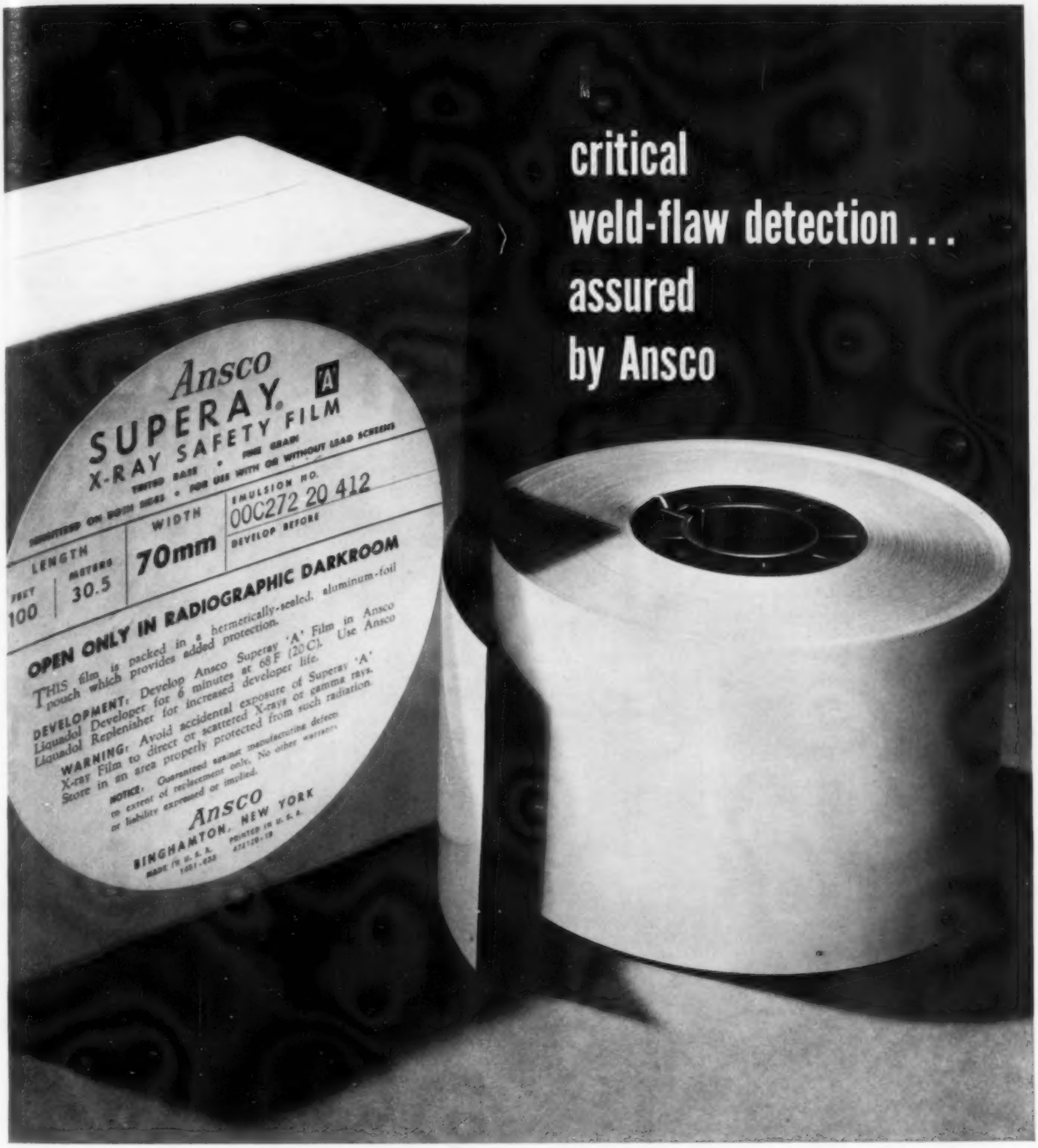

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PROPOSED CONSTRUCTION

continued

Northern Alberta Pipe Lines, Ltd., Edmonton, Alta., 110 miles, 10-inch, gas, main, Lac La Biche to Edmonton, $3 million, planned.

Northern Pipe Line Company, 153 miles, 16-inch, crude, from Regina, Saskatchewan, to Clearbrook, Minn., $10 million, planned.

Oasis Oil Co., of Libya, (Amerada, Continental and Ohio Oil Company), 86 miles, 30-inch, Dahra field to Es Sider, Libya; 36 miles, 20-inch, Mabruk to point between Es Sider-Dahra, before Libyan Petroleum Commission.

Peace River Oil Pipe Line Co., Ltd., 70-mile, crude, Swan Hills to Iosegun Junction, approved.

Petroleos Mexicanos, 4, 6 and 8-inch, products, Mexico City-Puebla to Cuernavaca, planned.

1,240 miles, 34-inch, gas, Reynosa to Mexicali, Mexico $160 million, negotiating with Tennessee Gas Pipeline Company for design and construction of the line.

360 mile, 12-inch, products, Minatitlan to Puebla and Mexico City, planned.

Products, Guadalajara to Tepic, planned.

Products, Aguascalientes to Zacatecas, planned.

6-inch, products, Guaymas to Ciudad Obregon, considered.

8-inch products, Guaymas to Hermosillo, considered.

8-inch, gas, Tierra Blanca to Veracruz.

Gas, Ciudad Carmen to Ciudad Pemex.

8-inch, crude Comalcalco to Minatitlan.

Crude, Minatitlan to Salina Cruz, contingent on proposed refinery on Pacific Coast.

149 miles, 10-inch, products, Ciudad Pemex to Minatitlan, planned.

181 miles, 4-inch, products, Mexico City to Salamanca, planned.

Pipelines of Puerto Rico, Inc., 95 miles, 8-inch, products, Penuelas to San Juan, Puerto Rico, approved.

Provincial Pipe Lines, Ltd., 700 miles, 3-16-inch, hydrocarbon line gathering system in Alberta, $25 million, before Alberta Oil and Gas Conservation Board.

Qatar Petroleum Company, Qatar, 60 miles, 6-10-inch, gas, Dukhan to Doha, Qatar, engineering contract let to Pencol Pipeline & Engineering Consultants.

Quebec Gas Transmission Lines, Inc., Montreal, 300 miles, gas, main, Quebec to Montreal, planned.

Rangeland Pipe Line Company Limited, 111 miles, 8-inch, crude, southeastern Alberta to Calgary, $3 million, planned.

Saskatchewan Power Corp., 179 miles, 4-6-8-inch, gas, planned.

Societa Nazionale Metanodotti, 650 miles, 18-inch, crude, Genoa, to Milan-Cremona-Torino, Italy, and Aigle, Switzerland, with extensions to Karlsruhe and Munich, Germany, planned.

Societe du Pipe Line Sud-European, Paris, 432 miles, 34-inch, crude, port of Lavera to Strasbourg, with lateral extending 40 miles to Karlsruhe, Germany, approved by French cabinet.

Soc. Siciliana Metanadotti, gas line from Hassi R'Mel field in Algeria through Tunisia, across Mediterranean to Sicily and into Italy, considered.

SOPEG, Paris, France, 225 miles 8-inch, gas condensate, Massi R'Mel to terminal on Hassi Messaoud to Bougie line in Algeria, contract let to **Grep and Socoman-Trapegaz.**

SOPEG, and **CREPs,** 400 miles, 30-inch, crude, connect Hassi Messaoud and Edjele fields in Algeria, contracts let to **Socoman and Grep, Groupement des Societies Entrepose et Parisienne Pour L'Industrie Electrique en Vue de L'Tude et La Pose de Pipelines.**

Standard-Vacuum Oil Company, 60 miles, 8-inch, gas, main, in South Sumatra, considered.

Ste. d-Etudes de Pipeline Intercontinetaux, Paris, 1,400 miles, 30-40-inch, gas, from Hassi R'Mel field in central Algeria across Mediterranean, through Spain, France and into West Germany, considered, Fish International Corporation making engineering and feasibility studies.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

130 miles, 16-inch, gas, main line, Multan to Lyallpur, planned.

Syrian Pipeline, Damascus, 500 miles, crude, from Karshuk field, Syria, to Mediterranean, planned.

300 miles, products, from Homs to tank farms in Damascus, Aleppo and Latakia, planned.

Trans-Canada Pipe Lines Limited, Toronto.

268 miles, 34-inch, loops, and additional hp planned for 1961, $69 million.

122 miles, 34-inch, loops, hp additions, $46 million, planned for 1962.

Trans-Prairie Pipelines, Ltd., Edmonton, crude line, from Weyburn field to Regina-Moose Jaw areas, $5 million, considered.

Trunk Pipelines Ltd., London, 70 miles, products, Canvey Island to Denham, Buckinghamshire, bill before Parliament. Extension of line from Denham to Birmingham, planned.

Westalta Products Pipeline Ltd., 900 miles, LPG, from Northern Alberta to Saskatchewan border, to deliver hydrocarbons to Foothills Pipe Lines, $40 million, before Alberta Board of Public Utilities Commissioners.

Williams-McWilliams Industries, Inc., New York, 441 miles, 6-inch, crude, Villa Montes, Bolivia, to Villa Hayes, Paraguay, considered.

Westcoast Transmission Company, 500 miles, 12-inch, crude, Taylor to Kamloops, B. C., $30 million, British Columbia government approval.

ON THE LINE

Pakistan Fuel Policy?

Although Pakistan doesn't have a National Fuels Policy, Sui Gas Transmission reported some interesting facts on a fuels study concerning natural gas and cow dung.

In the November issue of the company publication, Progress, an article belies the old belief that dried cow manure is the cheapest fuel to burn. Instead, it points out that the dung is far more valuable as a fertilizer—Pakistan imports fertilizers worth several crores of rupees a year. Natural gas where available, or charcoal or wood, would be cheaper to burn than dung. By utilizing the fertilizer, considerable foreign exchange could be saved by Pakistan.

One ton of dried dung is equivalent to about 18 Mcf of Sui Gas. However when used for heating and cooking, its relative value drops to 6-10 Mcf. How is this for "end-use control" of fuels?

Fire Schools

Ansul Chemical Company's 1961 fire school has nine sessions open for enrollment. The three-day sessions will run from May 22 to September 18.

School takes place at Ansul's Marinette, Wis., training ground. Actual fire fighting and advanced techniques are demonstrated at the school. Classes are limited to 25 men. Starting dates include May 22, June 5, June 12, July 24, August 7, August 14, August 28, September 11 and September 18.

Share in America

A sound-color movie "Share in America" has been produced by Sunray Mid-Continent Oil Co. and DX Sunray Oil Co. The 24 minute, 16 mm film is designed to combat and answer communistic propaganda, attacks against the American way of life.

Walter Cronkite of CBS News is narrator of the film, which is available for loan free-of-charge to all interested groups. The actors are people from every walk of life. The movie deals with Americans who are shareholders in the oil industry. It shows that industrial expansion made possi-

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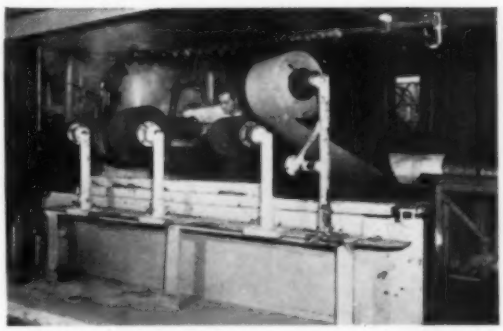

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ble by investments of shareholders in a typical integrated oil company. It also shows how different segments of the company, drilling, pipe line, etc., operate.

Film is available from Public Relations Department, Sunray Mid-Continent Oil Co., P. O. Box 2039, Tulsa 2, Okla.

Welding School

During the past two years 88 welders have been trained at the Tulsa welding school sponsored by the Pipe Line Contractors Association. These welders were trained at an average cost of $568 per student.

At its Fall business meeting the PLCA decided to appropriate additional funds to operate the school for another year.

LPGA Meets

Keynote speaker at the Liquefied Petroleum Gas Association meeting will be Frank M. Porter, president of the American Petroleum Institute. The thirtieth annual convention will be held April 30-May 3, at the Conrad Hilton Hotel in Chicago.

Emphasis this year will be on producer executives attending the meeting and the LPGA theme for 1961 is Spotlight on Potentials. "Exchange of business information through conversations between producer executives and LP-Gas marketers will set groundwork for realizing industry's expansion potentials," according to T. E. Ennet, convention committee chairman.

Three awards are to be presented at the meeting. They include the association's Distinguished Service life membership and the $1,000 Seley Award and Gold Medal, the H. Emerson Thomas Safety Award and the Miss International LP Gas crown.

Entering its tenth year of service to the industries that produce and distribute natural gas, Transco points with pride to the stability of markets it affords producers, and to the economies of transmission it affords customers. TRANSCO—the pipeline carrying natural gas to the markets where the most people are.

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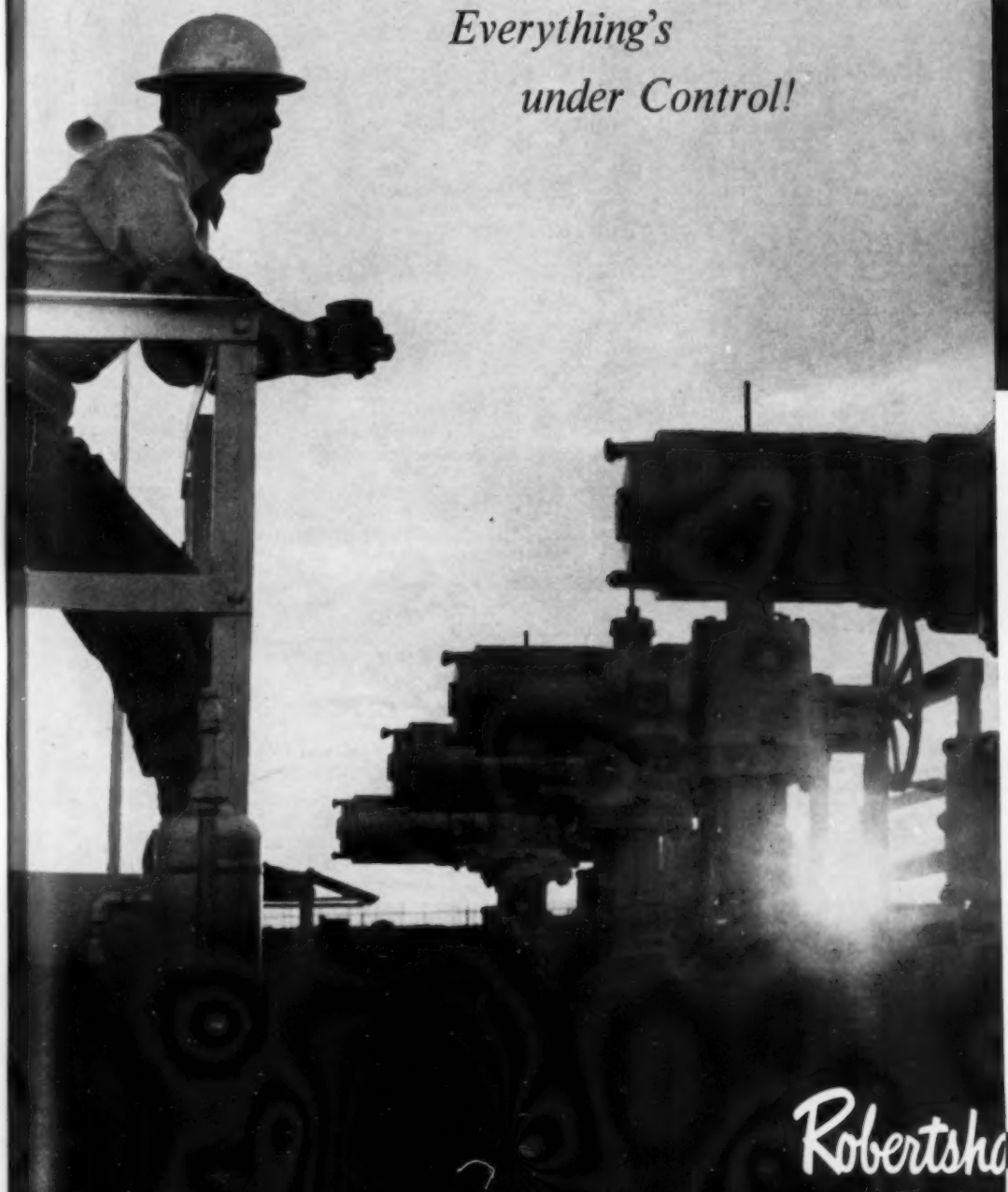

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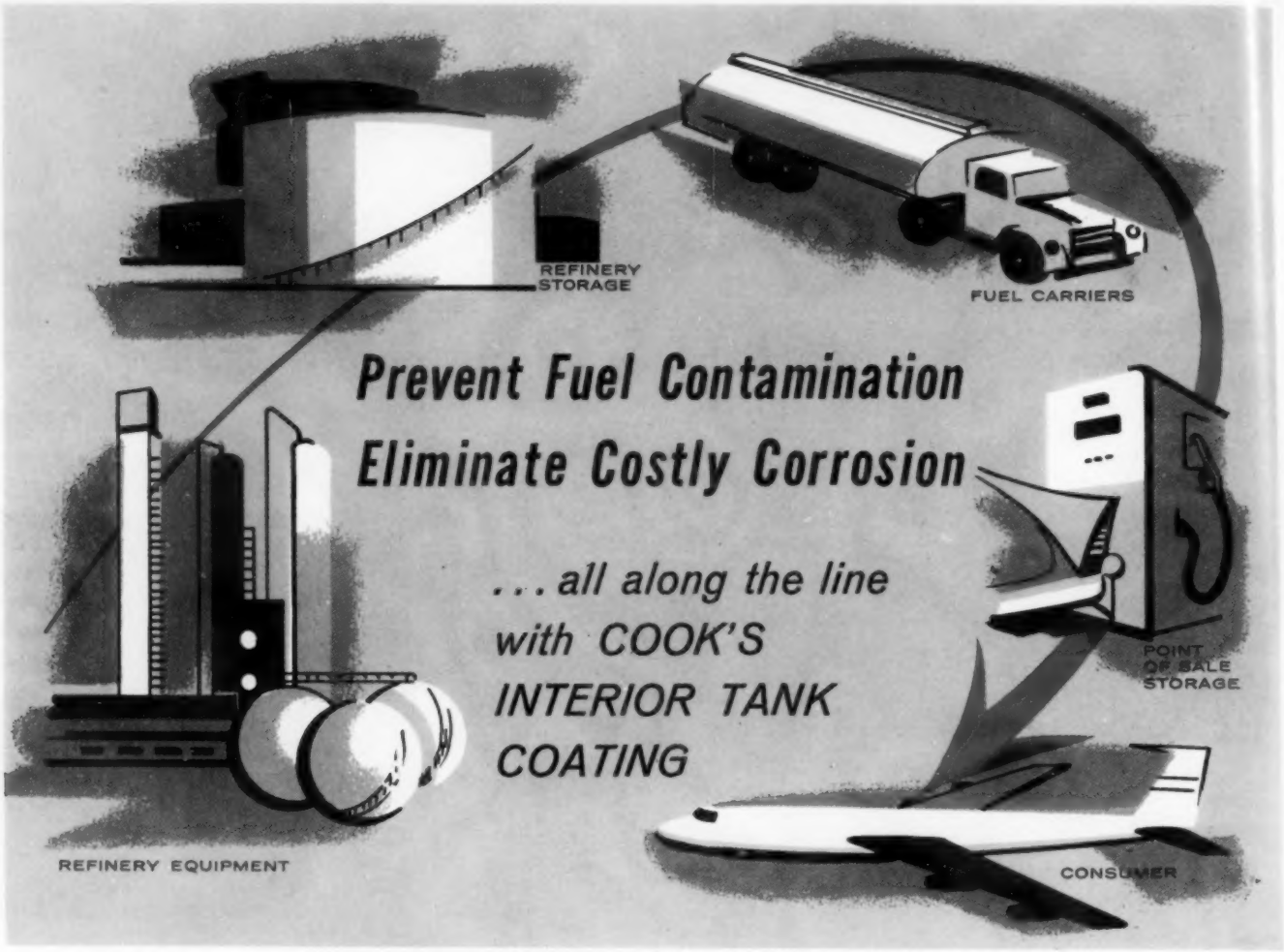
Aeronautical and Instrument Division, Robertshaw-Fulton Controls Company, Santa Ana Freeway at Euclid Avenue, Anaheim, California.



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From refinery to consumer, uncontrolled internal corrosion adds tremendous costs to storage and transportation operations every year. With over seven years of proved performance in the field, Cook's internal tank coatings have shown that they stop this vast waste . . . and at the same time provide positive protection against contamination of stored refined petroleum products.

Published data shows that corrosion may consume up to 20 mils per year from the interior of some uncoated product tanks. Every particle of a corrosion product contaminates the fuels and solvents, sold to consumers. What contamination of aviation gasolines and jet fuels . . . a result of corrosion . . . may cost refiners in reputation is incalculable.

You risk neither corroded equipment nor dirty fuel when you corrosion-proof the inside of refinery, transportation and storage equipment with Cook's Interior Tank Coating. You also meet the lining requirements as set forth by Specification MIL-C-4556-A, Fuel and Water Resistant Coating.

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Cook's Interior Tank Coating saves refiners labor, time, and money in important additional ways. It is normally applied in two coats. Its heavy body lends itself to uniform application to a total of 5 to 6 mils thickness—the minimum thickness for best protection.

Cook's Coating will withstand "steaming." There is no need to recoat inside surfaces after this cleaning operation.

A film of Cook's Interior Coating will protect inner walls from the corrosive action of salt and fresh water, as well as crude oil and most other petroleum products.

Cook's service is as dependable as Cook's products. Our experienced engineers will be glad to help analyze and recommend solutions for your own coating problem. Interior Tank Coating is only one of several related finishes and protective products offered by Cook's Paints. If you have a problem, we suggest you contact us *now*. For more complete information, apply to the headquarters of Cook's Paints nearest you. Addresses are listed below.

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What's Happening among MEN in the INDUSTRY

Howard S. McCray has been elected president of **Texas Pipe Line Company** succeeding **John W. Emison,** who will retire April 1, after 41 years service with the company.

H. S. McCray

Assistant to the president of **Texaco Inc.,** for the past two years, McCray has been with Texaco since 1926 when he joined the company as an engineer in the Port Arthur, Texas, refinery. He was elected chairman of the board and chief executive officer of the Texas-Zinc Minerals Corporation in 1958. In 1959, he was named assistant to the president of Texaco.

Columbia Gulf Transmission Company has named **Corder S. Reynolds** assistant chief engineer. He replaces **Charles W. Morrow,** who transferred to **Ohio Fuel Gas Company** as assistant chief engineer of Columbia Group companies of **Columbia Gas System.**

Reynolds has been with Columbia Gulf and its predecessor, Gulf Interstate Gas Company, since 1956. For the past two years he has been project engineer.

O. R. Burden Construction Corporation has announced reorganization of its company. Officers include **J. S. Burden,** president, who succeeds the late Oscar Burden. **Paul T. Thibodaux** is executive vice president and **William G. Eastman** is vice president, secretary.

P. E. Thibodaux and **George S. Downey** are vice presidents and **Edward O. Yelton** is treasurer and assistant secretary. **A. L. Lundberg** is general superintendent, domestic, and **M. T. Wilhite** is general superintendent, foreign.

C. D. Richardson has been appointed superintendent of the newly created Pennsylvania Storage Department of **Transcontinental Gas Pipe Line Corporation.** The new group is responsible for operations and maintenance of the 194-mile, 24-inch system which extends from the main line near Somerset County, N. J., to the natural gas storage area in western Pennsylvania.

The department will be staffed by **Robert M. Detamore, John S. Noel, W. L. Summers, Jr.,** and **Fred Lydic.**

Lewis C. Holder has joined **Trunkline Gas Company** as Houston district landman. He has worked as landman for Humble Oil & Refining Company and recently has been an independent oil operator.

Fred H. Moore was named executive vice president of **Mobil Oil Company** in charge of coordinating activities of marketing, manufacturing, supply and distribution, pipe line and traffic departments. Moore joined a Mobile affiliate in the Southwest 25 years ago.

H. L. Waszkowski, Jr., has been appointed vice president of the Exploration and Producing Department.

J. P. Miller, superintendent of **Service Pipe Line Company's** Levelland, Texas, district was moved to Beaumont, Texas, as district superintendent replacing **Jack Grant** who retired after 40 years service.

C. L. Wilson was transferred from Mineral Wells to Longview, Texas, as district superintendent. He succeeds **Lee May,** who was transferred to Hays, Kans.

Gene Hart has been appointed Mid-Continent advertising manager for PIPE LINE INDUSTRY and WORLD OIL magazines. He will be headquartered in *Gulf Publishing Company's* Tulsa office.

Gene Hart

Hart had been advertising sales manager for the company's PETROLEUM REFINER magazine since 1958. Previously he served as eastern advertising representative for the refining magazine in New York. Hart has been with Gulf Publishing Company since 1950.

J. R. Anderson has been appointed superintendent of **Buckeye Pipe Line Company's** Cleveland Trunk Line Division. He continues as superintendent of the company's gathering lines also. **Richard Garnjost** was named assistant superintendent of these divisions.

Mobil Oil Company has reorganized its West Coast Pipe Lines Division. **H. W. Witter,** formerly assistant to manager, becomes manager of operations. Pipe line operations are organized in six geographical areas, three in the San Joaquin Valley and three in Greater Los Angeles Basin. Area supervisors are **R. E. DaFoe, C. A. McDonald, J. W. Hazzard, G. F. Pitzer, A. W. Lemberger** and **C. A. Rhoton.**

J. B. Goza, Magnolia Pipe Line Company Houston Division engineer, was named manager of engineering. **W. C. Meek** becomes manager of rights of way

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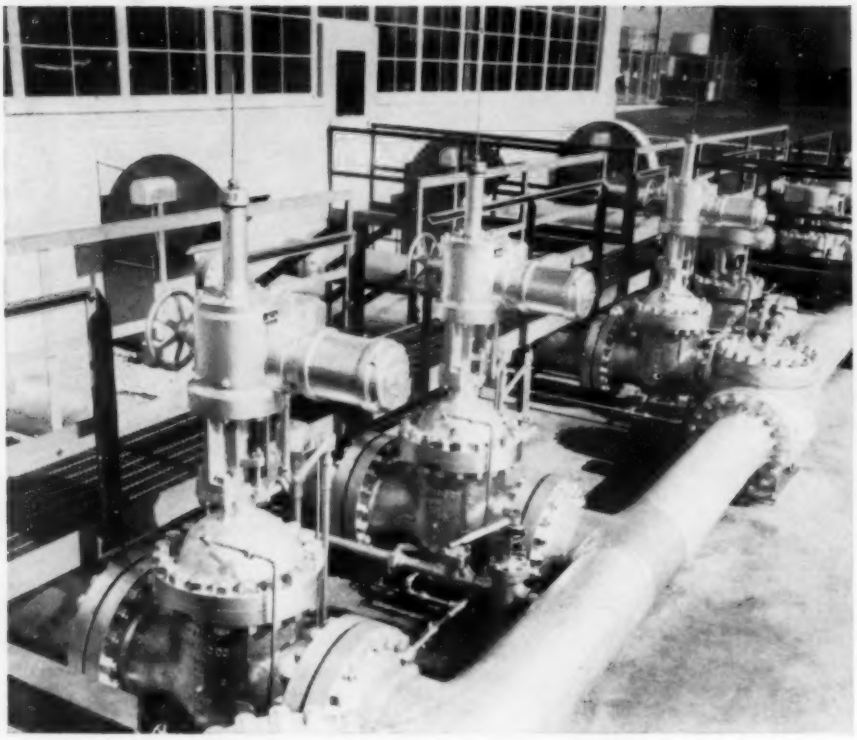

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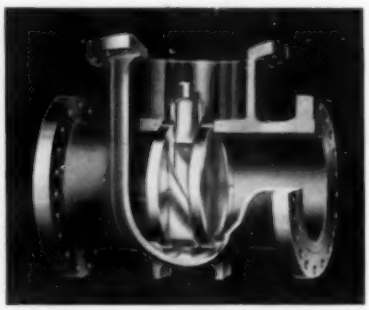

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and claims. **W. H. Webb** was named manager of oil movements. **C. D. Grant** will be assistant to **J. S. Black**, manager. **D. P. Dowling**, formerly Magnolia employee relations administrative assistant, was made manager of employe relations.

L. T. Sloan

Aaron H. Griffin

Texas Gas Transmission Corporation has announced several new appointments. **Aaron H. Griffin** was named manager of Louisiana Division, **William O. Davis** became manager of Pipe Line Division at Memphis, Tenn., and **L. T. Sloan** was appointed assistant manager of the Louisiana Division. **Wayne Sweet** was named assistant superintendent of the Measurement Department.

Davis has been with the company since 1945, and recently had been Louisiana division manager. Griffin joined Texas Gas in 1949, and was assistant superintendent in the Dispatching Department before his promotion. Sloan has been with the company for 23 years and had been assistant division superintendent in Pipe Line Department. Sweet, formerly assistant Louisiana Division manager, joined the company in 1943.

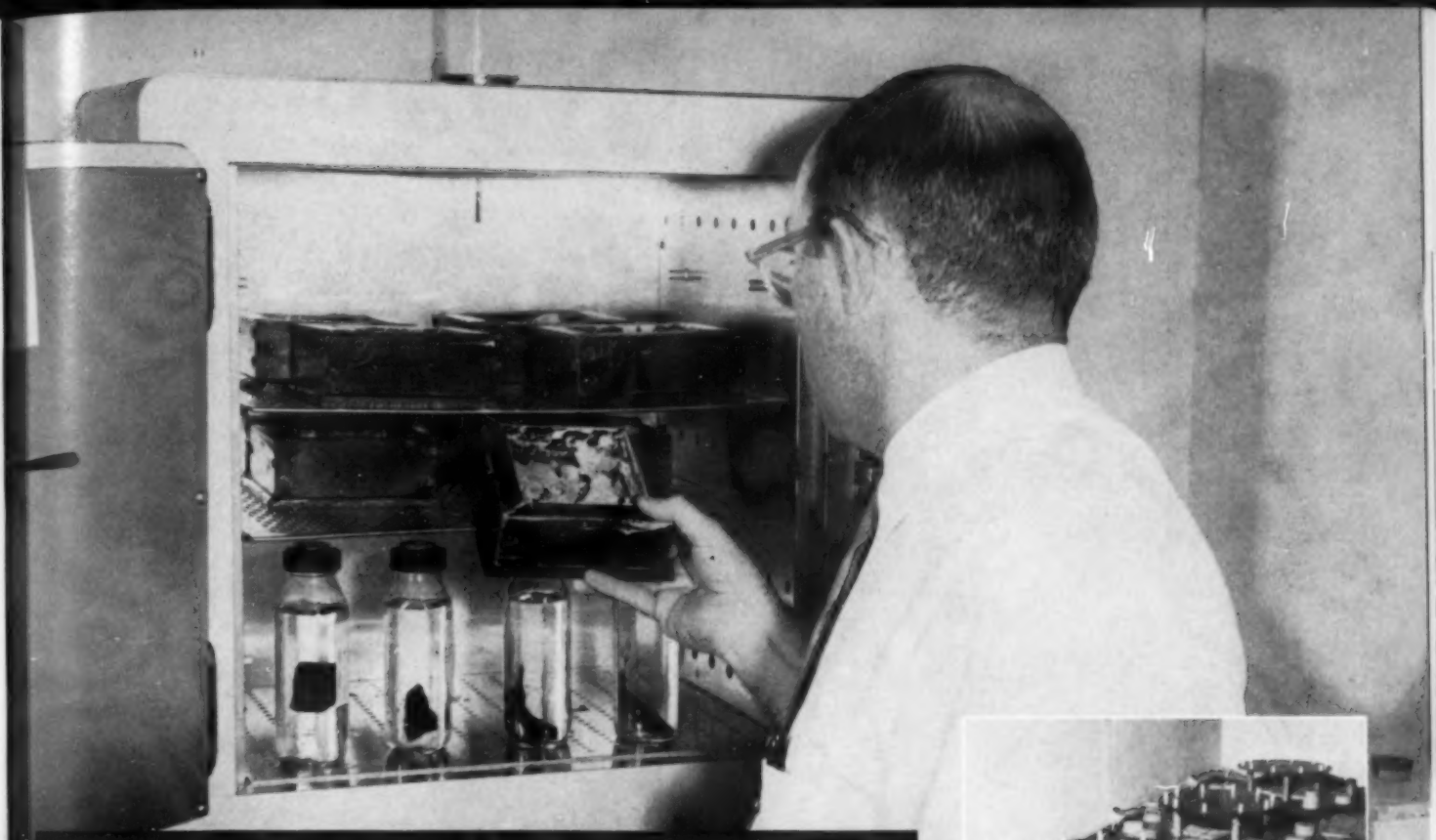
James A. Wilson, vice president of the Texas distribution division since 1954, has been transferred from Houston to the Shreveport general offices of **United Gas Corporation.** He will be in charge of distribution operations in Texas, Louisiana and Mississippi.

P. H. DuVal has been named manager of **Cities Service Petroleum Company's** Natural Gas Division. He moves to Bartlesville, Okla., from Shreveport where he had been in charge of natural gas sales for and crude oil supply and transportation for **Arkansas Fuel Oil Corp.** He joined Arkansas Natural Gas Company in 1929, and three years later was appointed to Arkansas Pipeline Corp. where he worked for 12 years. He was then transferred to the parent firm, Arkansas Fuel Oil Corp., as manager of crude oil supply and transportation.

John F. Stichman has been named assistant comptroller for **Sinclair Pipe Line Company.** He was succeeded as assistant chief accountant by **L. L. Fare.**

Several managerial appointments have been announced by **Pipe Line Technologists, Inc. Thomas M. Thawley** has been assigned to The Hague, Netherlands, as manager of European operations. He replaces **Richard S. Barfield** who returns to Houston supervising engineer-design.

O. C. Mudd, formerly chief corrosion engineer for **Shell Pipe Line Corporation,** has been assigned to Sydney, Australia, to assist **Milton E. Worlow,** manager of Aus-



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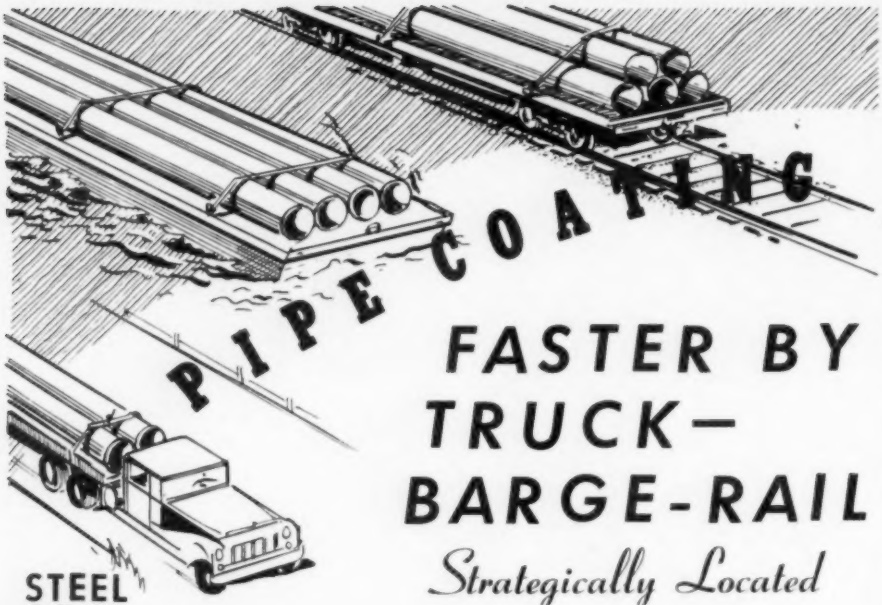

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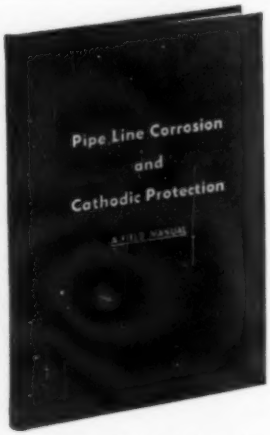

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tralian operations for Pipe Line Technologists (Orient) S.A. **Theodore L. Guerry** has been transferred from Venezuela to Houston. **Scott Hood** has been placed temporarily in charge of Venezuelan operations and **Frank E. Hangs** has been moved to the company's Canadian affiliate at Calgary, Alta.

The American Gas Association has named **Lorne S. Waddell** manager of communications, a newly created post. **Edward J. Reardon,** former city editor of the *Evening News,* Perth Amboy, N. J., succeeds Waddell as manager of press relations. Waddell has been with the AGA since 1958.

Great Lakes Pipe Line Company has incorporated its Research Department into its Engineering Department. **Bob Hancock,** formerly director of research, has been assigned to engineering and will concentrate on research development. **Bill Anderson,** formerly a research engineer, becomes an electrical engineer and will be primarily concerned with electronics and corrosion. **L. R. Becklund,** research technician, has become a draftsman.

S. O. Crichfield, engineer in the Technical Services Department, **Shell Pipe Line Corporation,** has been transferred to the BIPM at The Hague to act as a consultant on economics and feasibility studies on pipe lines in Europe. He has been with Shell since 1949.

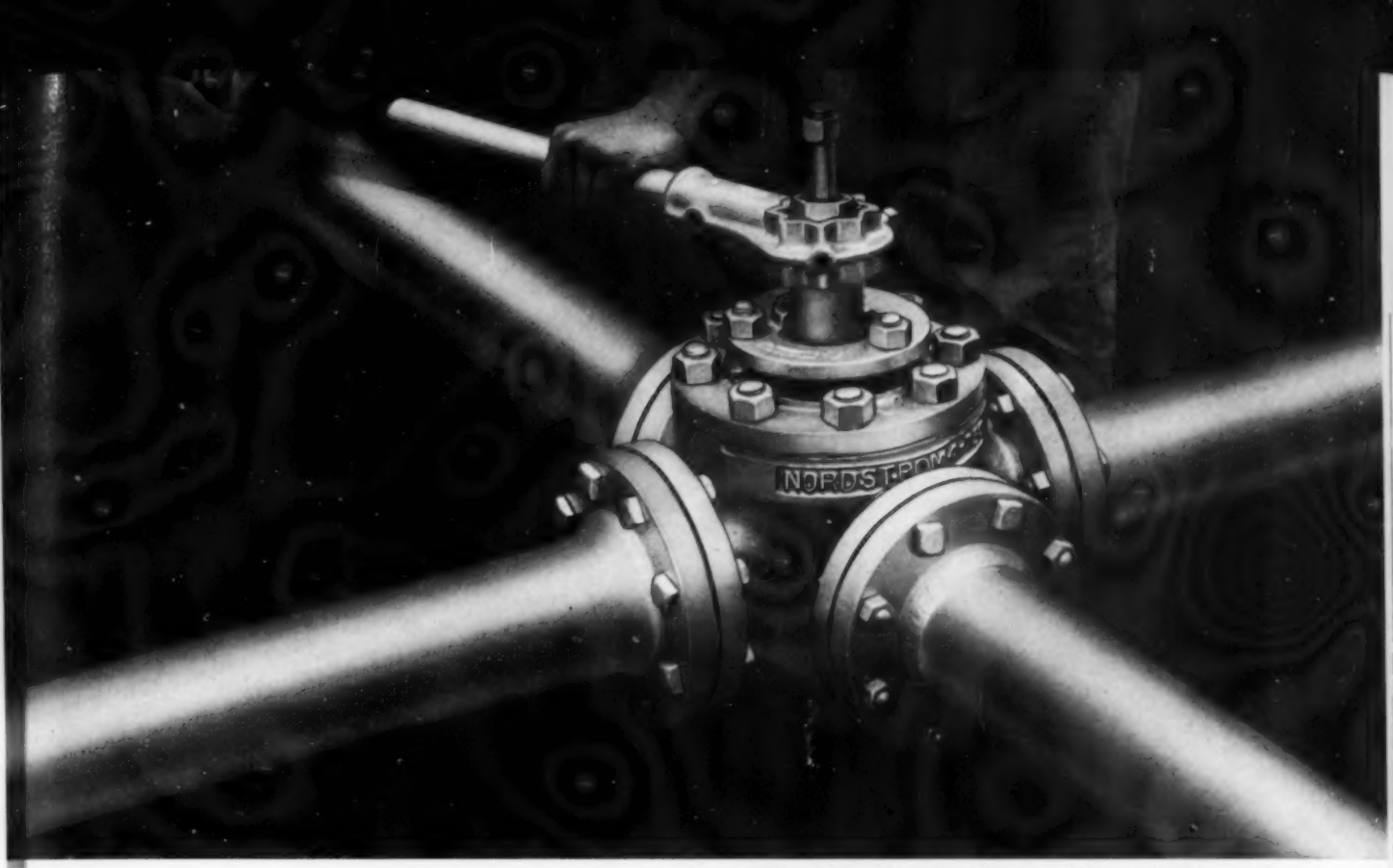
Howard C. Pyle, president and chairman of the executive committee of **Monterey Oil Company,** has been named a director of **Transwestern Pipeline Company.** He began his career in 1927 when he joined Union Oil Company as a geologist and petroleum engineer. He has been a vice president of the Bank of America and president of Continental Consolidated Corporation and became president of Monterey in 1951.

Howard C. Pyle

He is a member of the API, American Association of Petroleum Geologists, American Institute of Mining and the Metallurgical and Petroleum Engineers.

W. J. Greenwald has been named general manager of the Natural Gas Division of **Humble Oil & Refining Company.** The division is a newly created operating group in Humble's headquarters organization. It will be responsible for all sales of natural gas by the company.

John J. Carter has been named manager of the Natural Gas Division and will assist Greenwald. Greenwald has been serving as acting manager of Producing Investment Coordination of the company's Humble Division. His permanent assignment was chief engineer of the Production Department, Humble Division. He has been with Humble since 1940. Carter joined the company in 1934, and since 1955, has served as manager of Humble Division's Gas Department.



Imagine the savings in valves, flanges, piping and fittings made possible by this Rockwell Multiport lubricated plug valve.

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Rockwell-Nordstrom *Multiport* lubricated plug valves can slash costs and reduce operating problems where flow must be shunted in three or four directions. Since one Multiport can replace as many as four conventional valves, initial cost savings are great. Also, the costs of flanges, piping and fittings are substantially cut. Rockwell-Nordstrom Multiport valves can be provided in some 14 different arrangements to suit your manifolding.

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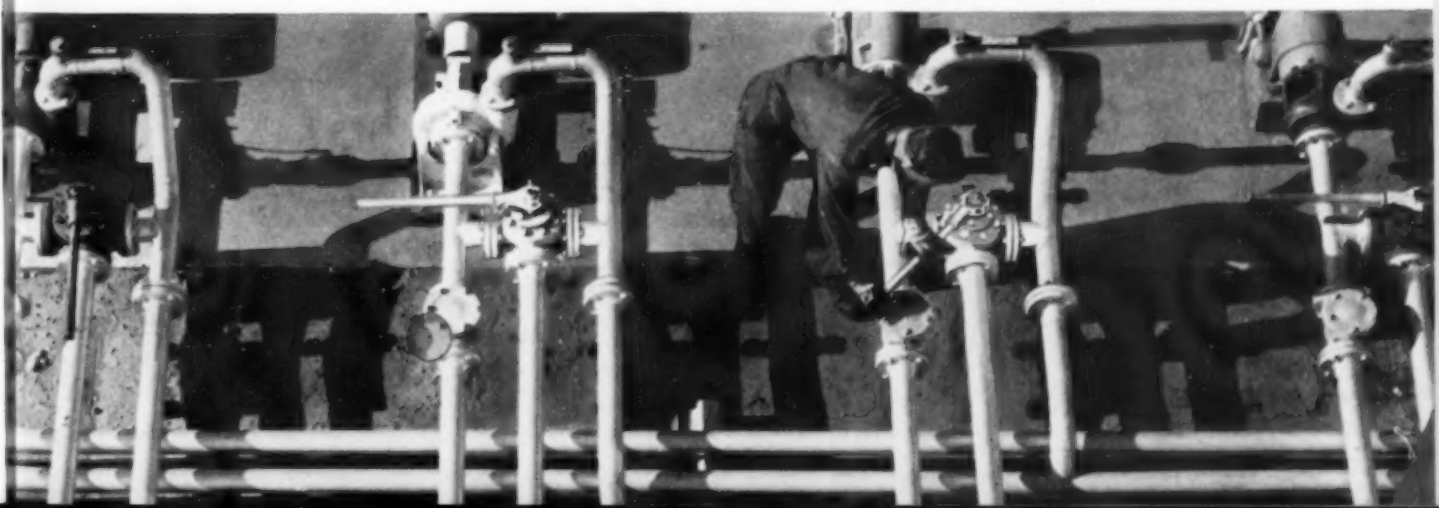

WHO'S MEETING WHERE

March

ASME, Gas Turbine Power Division, co-sponsored by the Department of Defense, sixth annual conference and exhibit, Shoreham Hotel, Washington, D. C., March 5-9.

NACE, seventeenth annual conference, Hotel Statler, Buffalo, N. Y., March 13-17.

New England Gas Association, annual meeting, Hotel Statler, Boston, March 15-17.

NGAA, 40th Annual Convention, Baker Hotel, Dallas, March 15-17.

AGA General Management Section conference, Frances-Marion Hotel, Charleston, S.C., March 20-22.

American Society for Metals, 12th western metal congress and exposition, Pan American Auditorium, Los Angeles, March 20-24.

American Power Conference, Sherman Hotel, Chicago, March 21-23.

Mid-West Gas Association, annual meeting, Sheraton-Fontenelle Hotel, Omaha, Neb., March 27-29.

University of Oklahoma, Schools of Petroleum and Gas Engineering, gas conditioning short course, Oklahoma Memorial Union Building, University of Oklahoma, Norman, Okla., March 28-29.

April

Gas Compressor Institute, University of Kansas, Liberal, Kan., April 4-5.

University of Oklahoma, School of Mechanical Engineering, short course of industrial engines, University of Oklahoma, Norman, Okla., April 6-7.

ASME, oil and gas power conference and exhibit, Jung Hotel, New Orleans, April 9-13.

ASME, maintenance and plant engineering conference, Bancroft Hotel, Worcester, Mass., April 10-11.

PIEA-PESA, annual meeting, Galveston, Texas, April 11-13.

University of Oklahoma, Southwest Gas Measurement Short Course, North Campus, Norman, Okla., April 18-20.

American Welding Society, meeting and show, Commodore Hotel, New York, April 18-20.

AIME Society of Petroleum Engineers, East-Texas, Louisiana, Arkansas gas technology symposium, Tyler, Texas, April 20-21.

Illinois Society of Professional Engineers, annual convention, Peoria, Ill., April 20-22.

Southern Gas Association, annual convention, New Orleans, April 24-26.

API, Division of Transportation, annual meeting, Chase Park Plaza Hotel, St. Louis, Mo., April 26-28.

NGAA, Oklahoma regional meeting, Lake Murray Lodge, Ardmore, Okla., April 28.

May

Pacific Coast Gas Association, transmission conference, Biltmore Hotel, Santa Barbara, Calif., May 4-5.

AGA, operating section, distribution and production conference, Sheraton Hotel, Philadelphia, May 8-12.

NGAA, Permian Basin regional meeting, Lincoln Hotel, Odessa, Texas, May 19.

ISA, AIEE, ARS, IAS, IRE, National Telemetering Conference, Chicago, May 22-23.

AGA, Operating Section, transmission, annual meeting, Brown Palace, Denver, May 25-26.

June

ASME, summer annual meeting, Statler Hilton Hotel, Los Angeles, June 11-14.

Canadian Gas Association, annual meeting, Grand Hotel, Mackinac Island, Mich., June 20-24.

September

AIEE, petroleum industry conference, New New Orleans, September 17-20.

ASME, petroleum division conference, Kansas City, September 24-27.

October

ASME-ASLE, lubrication conference, Morrison Hotel, Chicago, October 17-19.

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What's Happening among SERVICE and SUPPLY MEN

Southern Pipe Division Names Two Vice Presidents

Charles E. Lamar and Gordon C. Graham have been named vice presidents of Southern Pipe Division of U. S. Industries, Inc. Lamar joined the company in 1951 as sales engineer. He was promoted from manager of sales to vice president-marketing. Graham, formerly plant manager, is vice president of manufacturing. He has been with Southern since 1953.

F. W. (Bill) Ryser has been named sales representative by Southern Pipe Division for the Mid-Continent area. He will headquarter in Fort Worth.

W. J. Flaherty

D. W. McCabe

William J. Flaherty Becomes Houston Manager of Polyken

Polyken Sales Division announces the appointments of William J. Flaherty to newly created position of Houston manager. He had been eastern regional manager. Donald W. McCabe will replace Flaherty as eastern regional manager for Polyken Protective Coatings. Flaherty has been with the company for 8 years and McCabe joined the firm in 1953. McCabe recently served as assistant merchandising manager of protective coatings.

Pacific Valves, Inc., Sign Agreement with Weir-Valves

Pacific Valves, Inc., has signed an agreement whereby Weir-Valves, Ltd., will have manufacturing and marketing rights to Pacific's line of valves for petroleum industry.

Wheelabrator Forms Canadian Subsidiary

Wheelabrator Corporation of Canada, Ltd., has been formed to replace the Canadian Division of Wheelabrator Corporation of Mishawaka, Ind.

Harold M. Miller was named president and Robert A. Campbell vice president and general manager in charge of Canadian operations. J. D. Lamb becomes general sales manager. Officers include Jacob A. Schmidt, Jr., vice president; Edward T. Sullivan, secretary and treasurer, and James E. Donlan, controller.

Crane Packing Co. Names Chandler Vice President

Carlton N. Chandler has been appointed vice president-finance for Crane Packing Company. Formerly secretary and treasurer, he will continue as secretary. Glenn Moore was named to replace Chandler as treasurer. Previously Moore had been controller for the National Gas Cylinder Division of Chemtron Corp.

Reilly Tar & Chemical Corp. Names Bernard Assistant Manager

Dewey D. Bernard has been named assistant manager of the Coal Tar Enamel Products of Reilly Tar & Chemical Corp., with headquarters in Granite City.

W. J. Goldston Named Tex-Tube, Inc. Director

Tex-Tube, Inc., has appointed W. J. Goldston to the board of directors. Goldston is president of Goldston Oil Corp. and Goldrus Drilling Co. He is a former president of the Mid-Continent Oil and Gas Association.

Dunwoody Pipe and Supply Announces Two Appointments

J. Marcus Powell has joined Dunwoody Pipe and Supply Company as sales representative in West Texas with offices in Midland. C. A. (Chic) Bulot will be based in Dallas and cover North and East Texas and the Shreveport, La., area.

Cal-Metal Pipe Appoints Two District Representatives

Joe B. Byrd has been named sales representative for Houston, and Leonard E. Bodenhamer has been appointed to the Tulsa sales office of Cal-Metal Pipe Corporation. Byrd joined the company earlier this year and Bodenhamer has been with the company since November 1960.

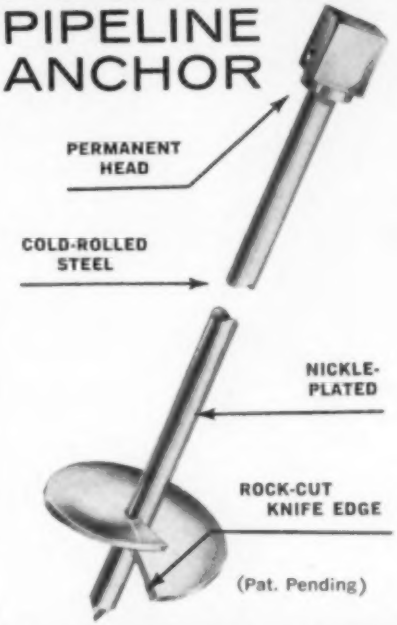
Union Wire Rope Corp. Merges With Parent Company

Union Wire Rope Corporation, a wholly owned subsidiary of Armco Steel Corporation, has been merged with the parent company. Union Wire Rope will continue to operate as a separate unit and all sales activities will continue with the same policies and same personnel as in the past. James H. Hatch, president of Union, becomes general manager.

Liccardi Named Chief Engineer Of Electro-Mech Corporation

Anthony L. Liccardi has been appointed chief engineer of Electro-Mech Corporation. Before joining the company, he had

NEW CORROSION-RESISTANT PIPELINE ANCHOR



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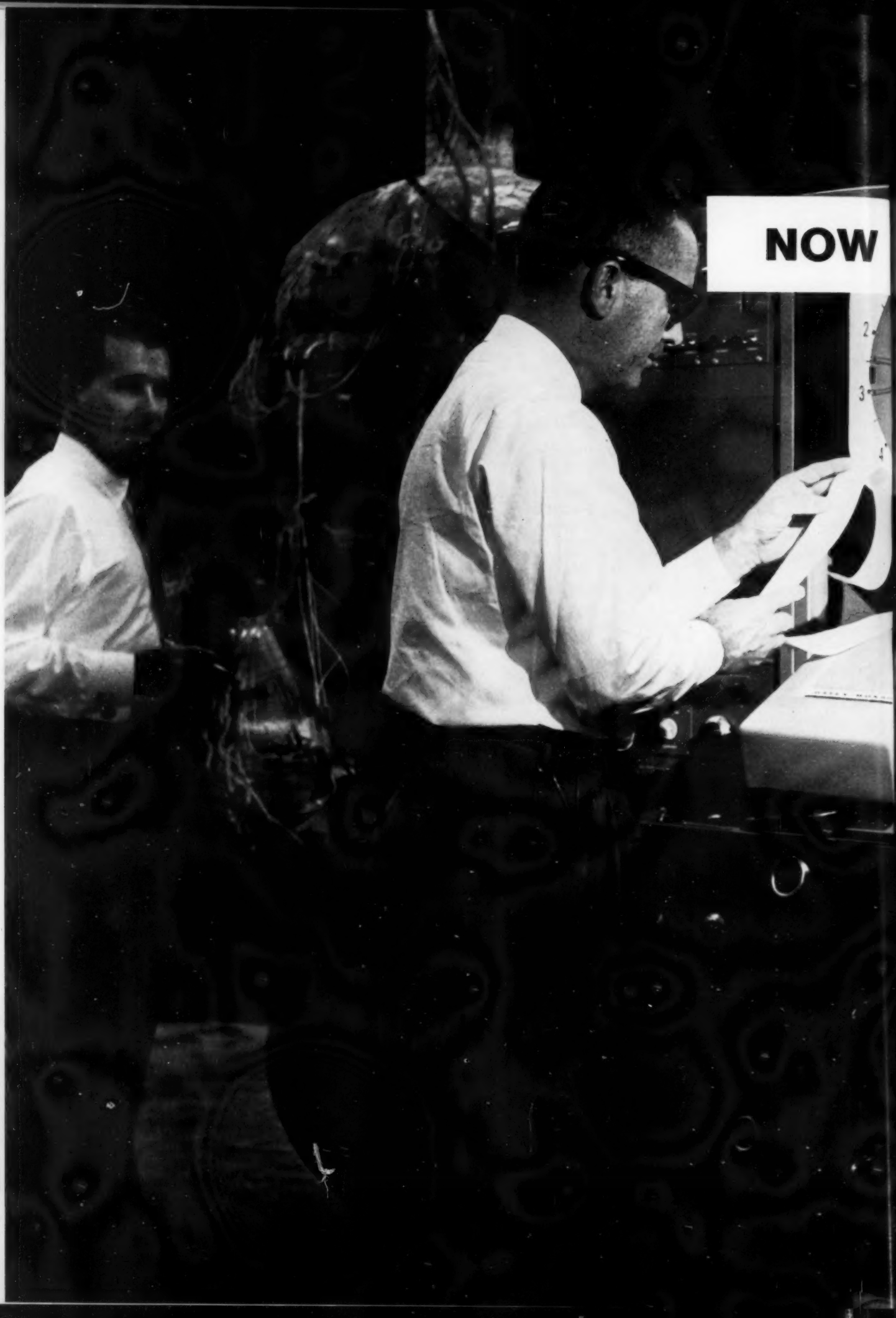
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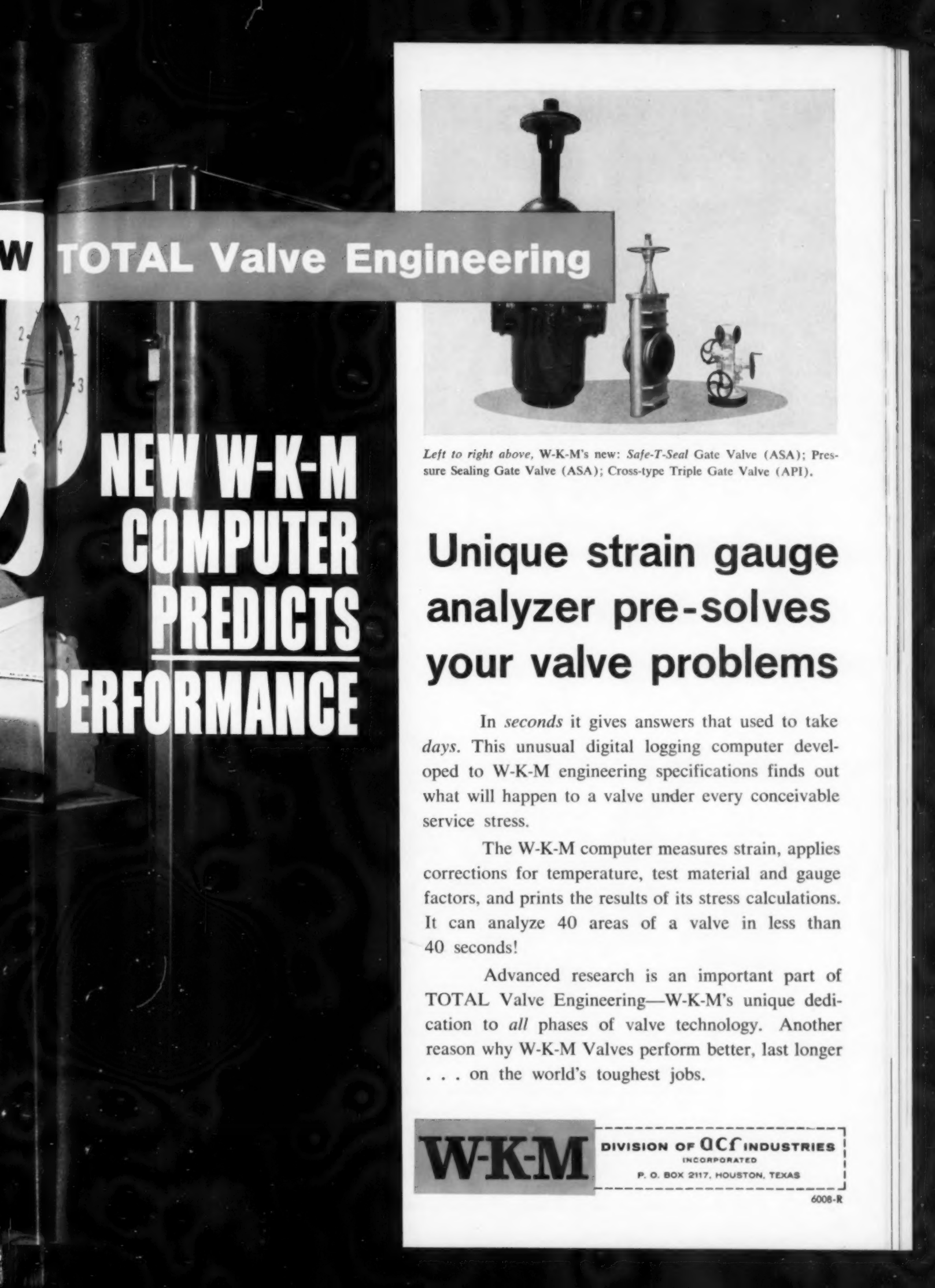


Left to right above, W-K-M's new: *Safe-T-Seal* Gate Valve (ASA); Pressure Sealing Gate Valve (ASA); Cross-type Triple Gate Valve (API).

Unique strain gauge analyzer pre-solves your valve problems

In *seconds* it gives answers that used to take *days.* This unusual digital logging computer developed to W-K-M engineering specifications finds out what will happen to a valve under every conceivable service stress.

The W-K-M computer measures strain, applies corrections for temperature, test material and gauge factors, and prints the results of its stress calculations. It can analyze 40 areas of a valve in less than 40 seconds!

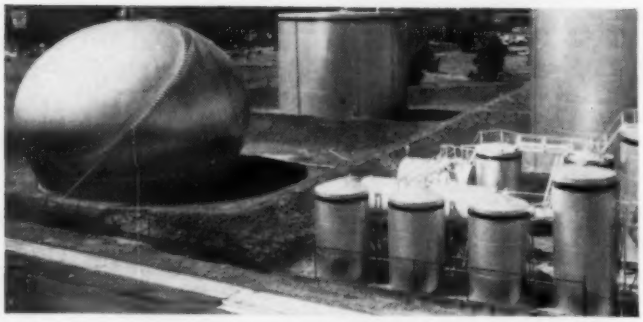
Advanced research is an important part of TOTAL Valve Engineering—W-K-M's unique dedication to *all* phases of valve technology. Another reason why W-K-M Valves perform better, last longer . . . on the world's toughest jobs.

W-K-M

DIVISION OF ACF INDUSTRIES
INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS

6008-R

Now! More Dead Weeds and Brush per Dollar



with UROX® WEED KILLER

One Application Gives 8 to 18 Month Control!

Here's the weed killer you can *positively depend on* to wipe out weeds and brush faster, easier, at lower cost and for a longer time than you ever thought possible. Urox weed killer effectively handles weed killing jobs along pipelines, on tank farms, around refineries and pumping stations, where weeds and brush are a constant fire hazard. In all these places, *just one application of Urox weed killer will remain effective for as long as 8 to 18 months!*

Longer lasting! Saves time and money! Urox weed killer has a cumulative effect on weeds and brush. Its herbicidal action can thus be extended from one year to the next with light booster doses. As smaller amounts are used over a period of time, you realize substantial savings.

Easy to use! *Liquid Urox* weed killer is ideal for spraying large overgrown areas. It won't clog spray nozzles or strainers! Won't precipitate out in the tank! Stays in solution perfectly! *Granular Urox* weed killer is the convenient inexpensive way to treat small weed-infested areas. Can be applied easily with any mechanical or hand-operated spreader.

New Urab® weed killer kills deep-rooted brush and weed trees! If you have problems with tough, deep-rooted weeds, brush or weed trees, *New Urab Weed Killer* is just what you're looking for. Urab weed killer actually *penetrates soil* to kill deep roots. Does what no other herbicide can! Supplied in liquid and granular forms.

*Trademark of Allied Chemical Corporation

Get the whole story! Mail this coupon!

Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N. Y.

Weed Killer Dept. PI-31
GENERAL CHEMICAL DIVISION
Allied Chemical Corporation
40 Rector Street, New York 6, N. Y.

☐ Please send me more information about General Chemical's amazing new herbicides, Urox and Urab.

☐ Please have representative phone for appointment.

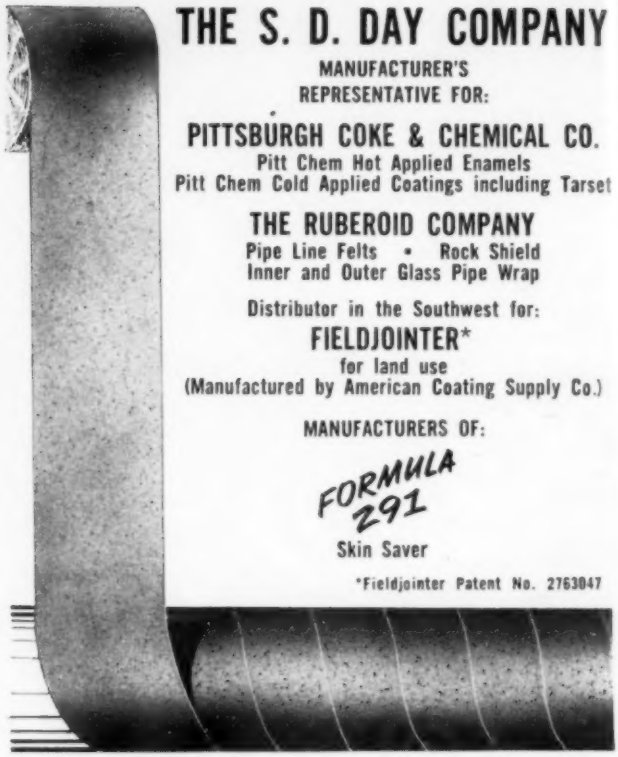
Name_____

Title_____

Company_____

Address_____

City_____ Zone_____ State_____



THE S. D. DAY COMPANY

MANUFACTURER'S REPRESENTATIVE FOR:

PITTSBURGH COKE & CHEMICAL CO.
Pitt Chem Hot Applied Enamels
Pitt Chem Cold Applied Coatings including Tarset

THE RUBEROID COMPANY
Pipe Line Felts • Rock Shield
Inner and Outer Glass Pipe Wrap

Distributor in the Southwest for:
FIELDJOINTER*
for land use
(Manufactured by American Coating Supply Co.)

MANUFACTURERS OF:
FORMULA 291
Skin Saver

*Fieldjointer Patent No. 2763047

"serving all pipelines"

S. D. DAY COMPANY
3115 BUFFALO DR., HOUSTON 19, TEXAS
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R. E. REUTZEL COMPANY INC.

PIPELINE CONSTRUCTION
FABRICATION
&
MAINTENANCE
FREMONT, NEBR.

Phone PA 1-1603
Box 727

been in charge of controls and instrumentation for the Loewy Hydropress Division of Baldwin Lima Hamilton Corp.

Allis-Chalmers Renames Pump and Compressor Depart.

Allis-Chalmers Manufacturing Company has changed the name of its Pump and Compressor Department to the Fluid Dynamics Department.

Tube Process Corp. Names Hood President

J. Hood has been appointed president of Tube Process Corp. He joins Tube Process after serving as assistant to the general manager of Baroid Division National Lead Company. Tube Process was founded in 1958, and is an internal pipe lining corporation.

J. Hood

Hood has 24 years experience in the drilling and production phases of the oil business.

Scharf Manufacturing Manager For Information Systems, Inc.

Albert Scharf has been named manufacturing manager for Information Systems, Inc., Computer Division. Scharf had been associated with American Electronics.

Flexonics Corporation Names Lloyd G. Fox Vice President

Lloyd G. Fox has been named vice president and director of marketing for Flexonics Corporation. He had been product sales manager since joining the company in 1960. Previously, he had been with Wolverine Tube Division of Calumet & Hecla, Inc.

Gordon Bennett Elected President of Whitlock

Gordon Bennett has been elected president of Whitlock Manufacturing Co. Formerly an executive vice president, Bennett succeeds Waldron C. Beekley, who is retiring.

Bucyrus-Erie Co. Official Named Association President

Lewis C. Black, vice president of Bucyrus-Erie Co., was elected president of the Power Crane and Shovel Association. Black has been with Bucyrus-Erie since 1935, and last year served as a director of the PC&SA.

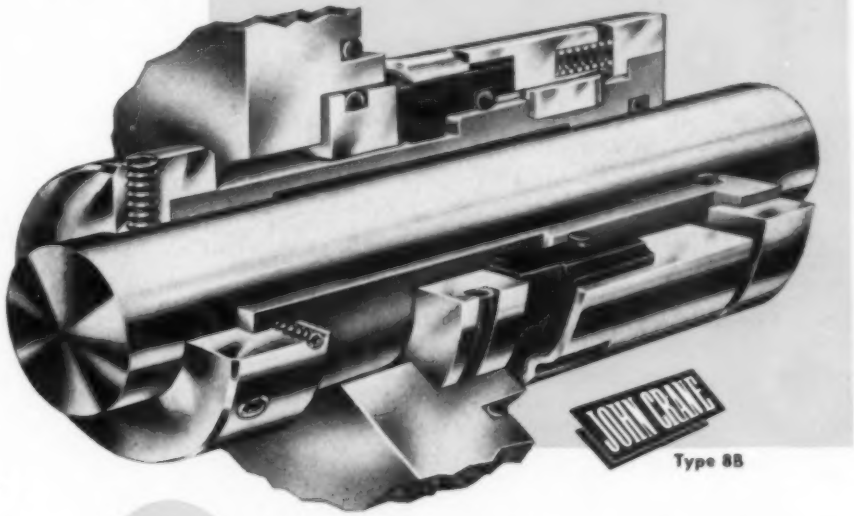
Air Reduction Appoints Moody Sales Manager

N. F. Moody has been named regional sales manager of Air Reduction Sales Company's eastern region. Moody started with Airco in the Chicago district in 1946. Prior to his promotion he was district manager for Philadelphia.

Hazel Named Vice President Of Oil Well Supply Division

M. F. Hazel has been named vice president of the Oil Well Supply Division of United States Steel Corporation. Hazel has been with the company since 1930, and

THIS IS THE SEAL USED IN 75% OF ALL RECENT PIPE LINE PUMP INSTALLATIONS



Type 8B

These Important Facts Tell Why

Reports from the field reveal that after 2½ years of continuous operation "John Crane" Type 8B Seals are still in perfect operating condition. This adds up to over 20,000 hours without shutdown!

Man-hours are being saved. The 8B is quickly installed and adjusted simply by sliding the entire unit along the shaft into position. The top casing need not be removed.

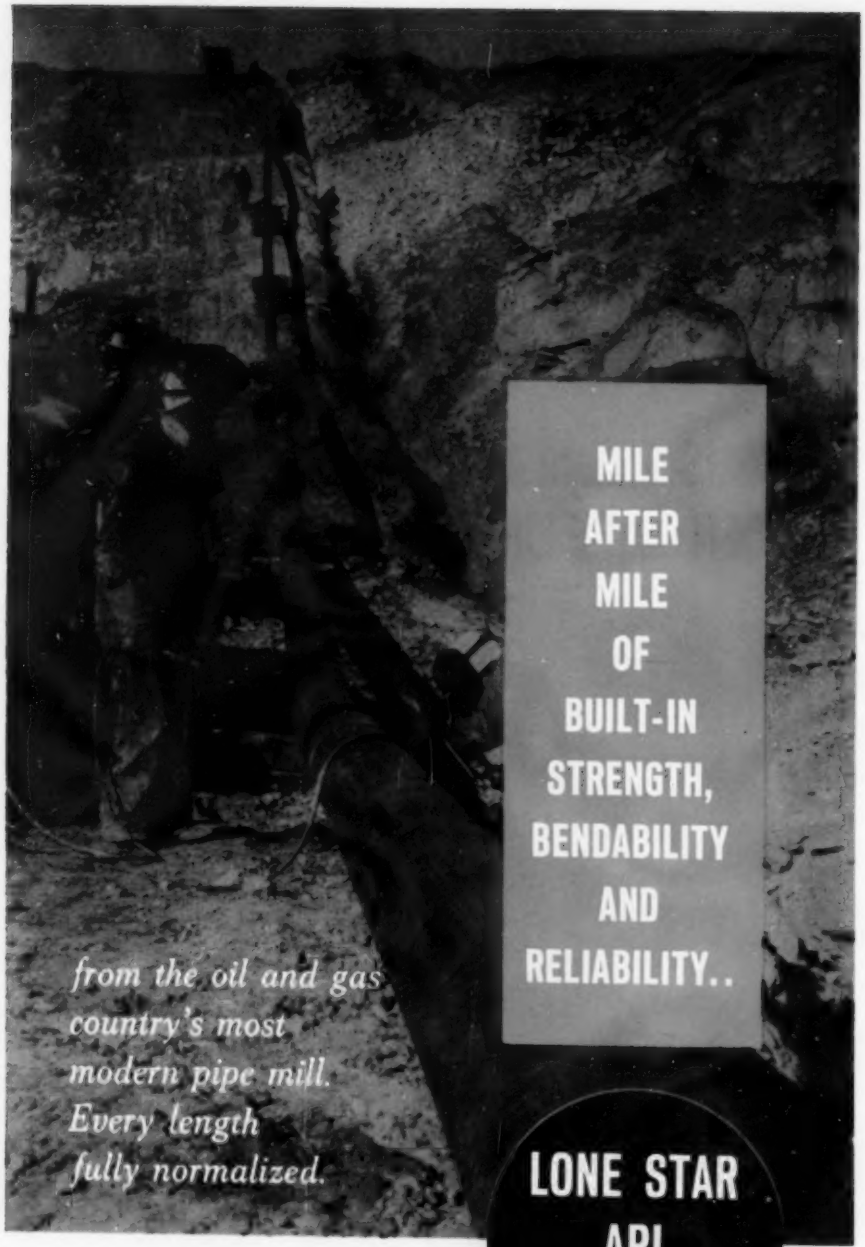
High pressure problems are eliminated. "John Crane's" exclusive hydraulically balanced construction permits handling of pressures up to 1200 psi.

The 8B comes in a full range of sizes to meet individual specifications and can be engineered to practically any on-the-job requirement.

Be sure you get "John Crane" 8B Seal performance. **Contact Crane Packing Co., 6434 Oakton Street, Morton Grove, Illinois (Chicago Suburb).**

In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

CRANE PACKING COMPANY



Joe Roughneck's Pipe Mill

Lone Star STEEL
COMPANY

EXECUTIVE—SALES OFFICES
W. Mockingbird Lane at Roper • P. O. Box 12226 • Dallas, Texas
DISTRICT SALES OFFICES
912 Republic National Bank Building, Dallas, Texas
Houston, Texas | Midland, Texas | Tulsa, Oklahoma

was made vice president-sales in 1955.

James E. Chenault, Jr., has been named area manager of the Canadian area of Oil Well Supply Division. He will be located in Calgary, Alta. He joined the company in 1948 as an auditor. R. L. Armstrong has been appointed area manager of the Rocky Mountain area with headquarters in Denver. Since 1959 he had been with Oilwell Supply Company, Ltd., London.

Pittsburgh Chemical Names Sales Manager and Assistant

J. B. Himmelrich has been named sales manager for pipe line coatings of the Protective Coatings Division of Pittsburgh Chemical Company and W. D. Moore was appointed assistant sales manager.

Himmelrich was eastern territory regional sales manager and now is headquartered in Pittsburgh. Moore formerly was sales representative in the Kansas City area.

Caterpillar Engine Dealer Established in Houston

A Caterpillar Tractor Co. engine dealer, Zagst, Inc., has been established in Houston at 7125 Navigation Boulevard. The company will provide sales, parts and services for the full line of Caterpillar diesel and natural gas engines.

The company is headed by Charles O. Zagst, who has 20 years experience in the diesel and natural gas engine applications.

Gragg and Associates Form Sooner Boomer Sales Company

The Sooner Boomer Sales Company has been formed by C. Hubert Gragg and associates Ellis Gragg, Jack Anderson and Nell Richardson. The new company will handle the sooner boomer and "little boomer" side-boom pipe laying equipment. Offices will be located at 223 N.W. Britton Avenue, Oklahoma City.

Knodle Joins C-B/ Southern

John Knodle has joined C-B/Southern, a Division of the Cooper-Bessemer Corporation. He had been with Mobile de Venezuela for 3½ years.

Cochrane Corp. Names German General Manager

Vernal C. German has been named general manager of the Cochrane Corporation. Previously German was sales vice president of the Cochrane Division in Toronto. Cochrane is a Division of Crane Co.

Walker and Associates, Inc., Expands Office Facilities

Walker and Associates, Inc., has expanded office facilities in the Montrose National Bank Building, Houston, and announces two administrative appointments. Thomas M. Johnson, Jr., has been named chief engineer.

Instruments and Controls, Inc., recently established subsidiary of Walker and Associates, is planning a new manufacturing plant at 6127 Gessner Road, Houston. The 72,000-square foot plant will be completed in April. Don Winden, owner of MVS Sales Company, has joined Instruments and Controls as a vice president and director. Instruments and Controls was formed to design and manufacture automatic control panels for use in pipe line and refinery industry.

For more data on advertised products, use Readers' Service Cards, last page.

CURTIN PETROLEUM GAGING EQUIPMENT

CURTIN API TANK THERMOMETERS with **EVERLAST®**

Fused-In Graduations are guaranteed accurate within one scale division. Lens-front, red-reading tubes with precision graduations permanently fused into the glass assure lifelong accuracy. Finest quality hardwood cases are fitted with non-sparking metal parts.

Finest in the Field . . . or in the Lab

CURTIN PLASTIC 3-PLACE HYDROCASE®

Securely holds three hydrometers up to 16¼ inches long. Lightweight, durable and convenient, the sturdy case provides separate, felt-lined compartments for each hydrometer. Forty-five degree angle cut of lid insures against breakage when lid is opened or closed.

For complete descriptive literature write W. H. Curtin and Company, P. O. Box 118, Houston 1, Texas.

W.H. CURTIN & CO.

LABORATORY APPARATUS, FURNITURE & CHEMICALS

HOUSTON • DALLAS • TULSA • NEW ORLEANS
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CURTIN DE MEXICO, S. A. DE C. V. MEXICO, D. F.

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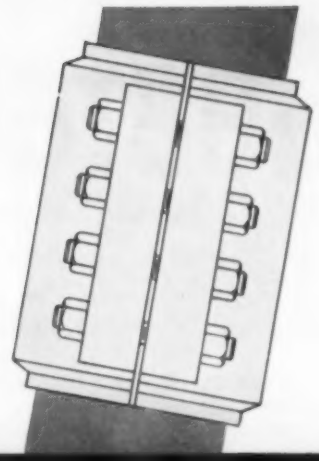
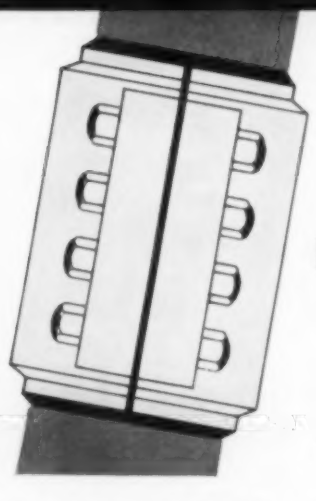


Completed Installation

FAST, SAFE PIPELINE REPAIRS WITH NEW SMITH SPLIT-COUPLING

The Smith Split-Coupling can be used as coupling, repair clamp or split sleeve.

Easy installation—Place halves around pipe. Tighten side bolts. **Permits welding while pumping.** Available in standard pipe sizes. Extra lengths and special dimensions on application.



Completed Installation (When welding is specified)

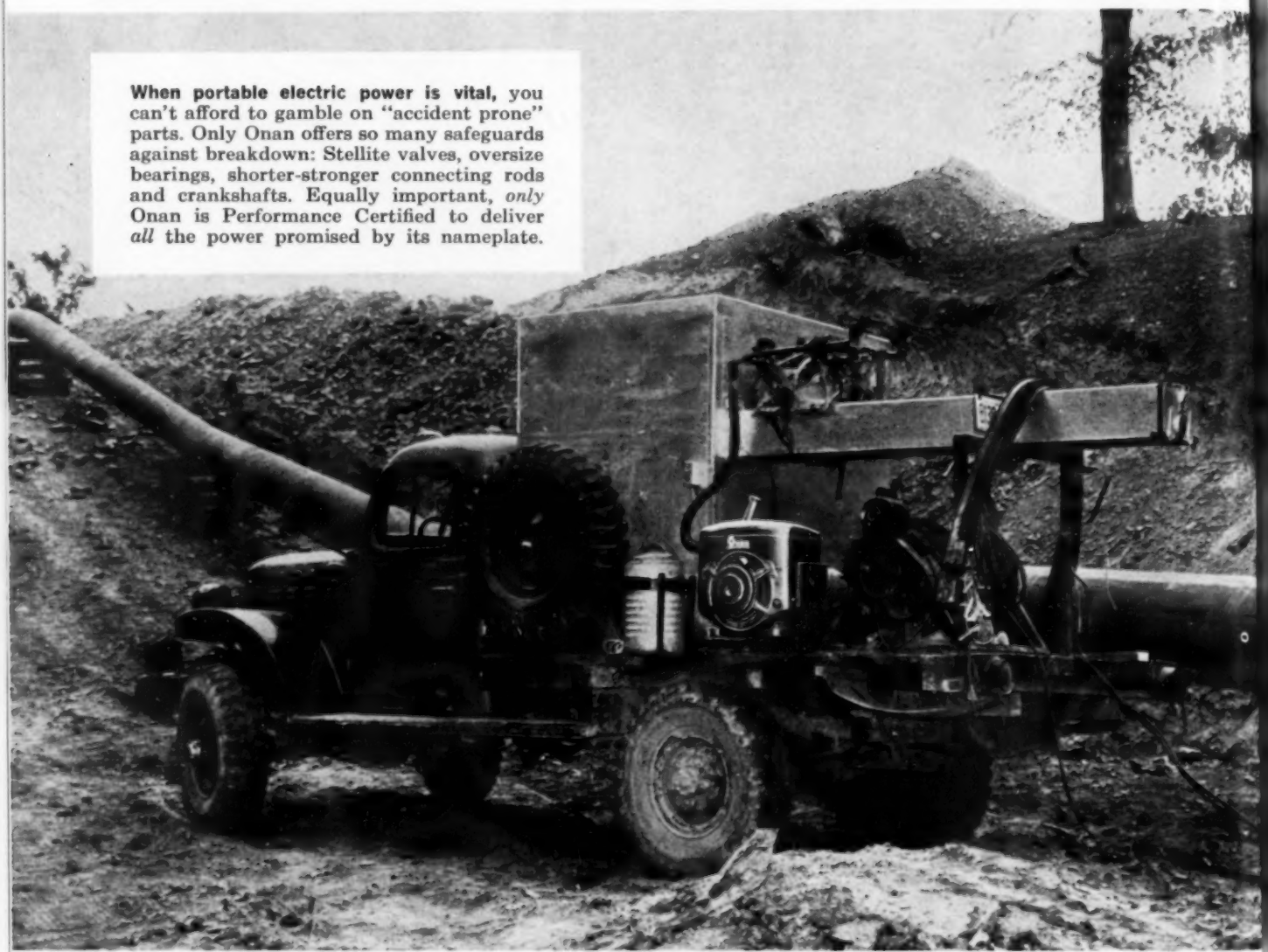
THE PIPE LINE DEVELOPMENT COMPANY

5700 Detroit Avenue
Cleveland 2, Ohio

REPRESENTATIVES THROUGHOUT THE WORLD

Beefed up for hardest

When portable electric power is vital, you can't afford to gamble on "accident prone" parts. Only Onan offers so many safeguards against breakdown: Stellite valves, oversize bearings, shorter-stronger connecting rods and crankshafts. Equally important, *only* Onan is Performance Certified to deliver *all* the power promised by its nameplate.



Stellite coated exhaust valves and valve seats. One of toughest alloys known. Gives you up to 300% longer valve life than uncoated valves. It's the important details like this that make Onan more economical in the long run.

Exacting standards govern manufacture—years of specialized experience and extensive testing facilities control the quality of Onan Power Plants. Over 1000 different types and sizes of plants are produced by Onan.

use...even abuse

Onan electric plant still delivers full power after 12,197 hour test—equal to 487,888 miles

A grueling endurance test that lasted one year, nine months and 12 days could not stop Onan test plant #1068. Onan engineers used this production-built unit for an endurance run—and after it was all over, it still generated the full rated power promised on the nameplate. Proof that Onan's exacting standards and production testing give you a power plant with long, dependable life built in.

Over 1,700 other endurance units have been run by Onan engineers. In these tests every design feature and part has to prove itself before it can become a part of the Onan you buy. In addition, every type and size Onan plant is tested under all operating conditions which could conceivably affect performance on your job.

Hours of running in and testing under full load are given *every* Onan before it is shipped. An independent testing laboratory then spot tests Onan Plants that have already been tested by Onan—double assurance that every Onan will deliver its full nameplate rating. Only then does an Onan production run qualify for Performance Certification.

Buy *proven performance* when you buy an Electric Plant. See your authorized Onan distributor or dealer. You can depend on him for a lifetime of factory parts and service. He's listed in the Yellow Pages.

ONLY ONAN GIVES YOU THIS CERTIFICATION

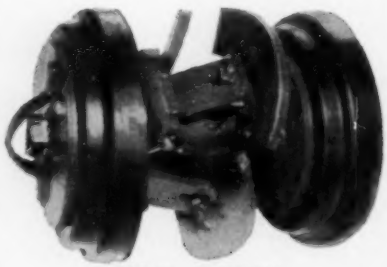
Onan
Onan
PERFORMANCE CERTIFIED
We certify that when properly installed and operated this Onan electric plant will deliver the full power and the voltage and frequency regulation promised by its nameplate and published specifications. This plant has undergone several hours of running-in and testing under realistic load conditions, in accordance with procedures certified by an independent testing laboratory.

World's Leading Builder of Electric Power Plants

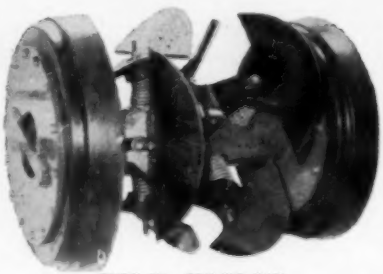
ONAN DIVISION, STUDEBAKER-PACKARD CORPORATION • 2689 UNIVERSITY AVE. S. E., MINNEAPOLIS 14, MINNESOTA

If you have a special problem...

we can help you!



TYPE HI—6" TO 18"



TYPE HI—20" TO 36"

TYPE HI—6" to 36"

The latest development in pipe cleaning tools.

CONSTRUCTION

These springs extend through the center of the unit to blades on the opposite side of the unit which gives it a maximum of flexibility. The heavy springs on this unit help to keep it centered in the pipe supporting its own weight which will give far greater cup life.

DESIGN

This unit is ideal for first run on new construction, or for extremely corroded pipelines.

PIPELINE CLEANERS CO.

FORT MADISON, IOWA
PHONE DRake 2-2051

What's New in EQUIPMENT

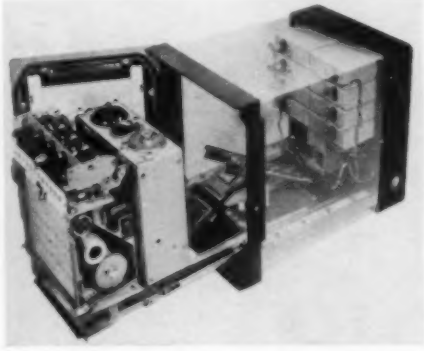
Thermoelectric Generator For Cathodic Protection

Northern Illinois Gas Company will install a thermoelectric generator for cathodic protection use on its pipe line and for charging batteries of microwave relay communications systems. The 100-watt unit was designed and built by Westinghouse Electric Corporation and is one of the first industrial applications of thermoelectric power generators.

The unit consists of two 50-watt sections stacked one on the other. Propane gas is burned in an assembly at the base of the unit and the resultant hot gases pass through a central insulated chimney. A number of thermoelectric "couples" are mounted around the outside of this chimney; they generate electric power as the heat is transferred through them. The hot side of these couples operate at about 400° C. Heat is dissipated through anodized aluminum fins to the surrounding air. Output of the basic generator is 11 volts at 10 amperes DC. A static converter operating at about 88 percent efficiency changes this output to 48 volts at 2.1 amperes DC. The unit weighs about 75 pounds.

The units will be used at stations in areas where electric power is not available. They also can provide power for station's meters, valve control and in microwave relaying equipment. The unit also will be used as part of a research program by Northern Illinois that will investigate additional applications of the generators.

For more data, circle **No. E1** on Readers' Service Card, last page this issue.



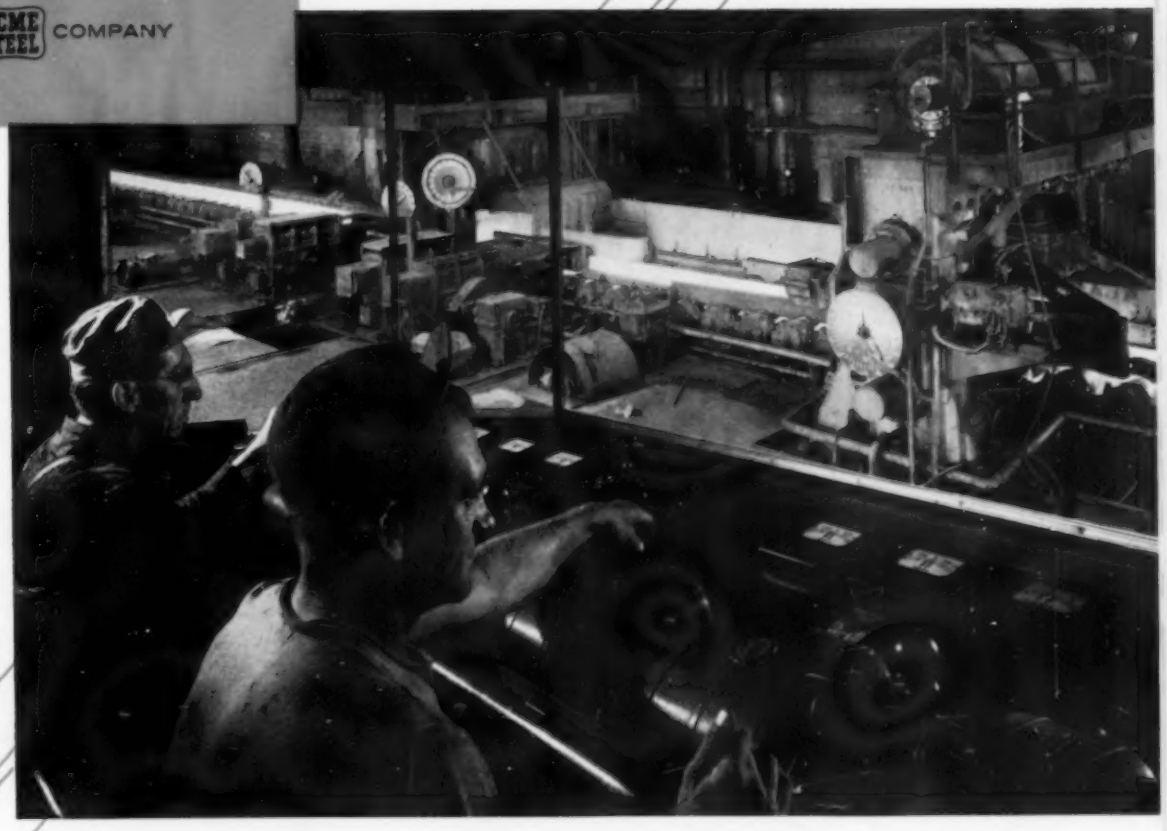
Potentiometers

A new potentiometer, ElectroniK 17, has been developed by Brown Instrument Division of Minneapolis-Honeywell Regulator Company. Heart of the measuring system is a newly developed Stranducer. A change in input drives the motor in one direction or the other, increasing tension on two of the Stranducer wires and decreasing it on the other two. This changes the electrical resistance of the wires, and continues to change it until the bridge is electrically rebalanced, at which time the motor stops moving. Rotation of the balancing motor shaft is reduced through drum and sector stages so that the move-

Acme-Newport Steel COMPANY

NEWPORT, KENTUCKY

A SUBSIDIARY OF ACME STEEL COMPANY



PRESCRIPTION

FOR BETTER LINE PIPE*

Experience, Youth, Modern Facilities

At Acme-Newport you have a time-tested formula for unexcelled quality in electric weld line pipe . . . a combination of 75 years' steelmaking background, efficient new facilities, men with long experience and with youthful drive. Over 25% of the personnel have served 25 years or more, while young men continually are being well trained to maintain the quality traditions of this basic steel producer.

The result is consistent pipe performance on which you always can depend. Every length is true round and uniform in wall thickness. It bends readily, welds easily, installs and functions trouble-free. Available in 4″ and 6″ sizes, standard or thin wall. Ask for complete information.

ACME-NEWPORT STEEL COMPANY, NEWPORT, KENTUCKY

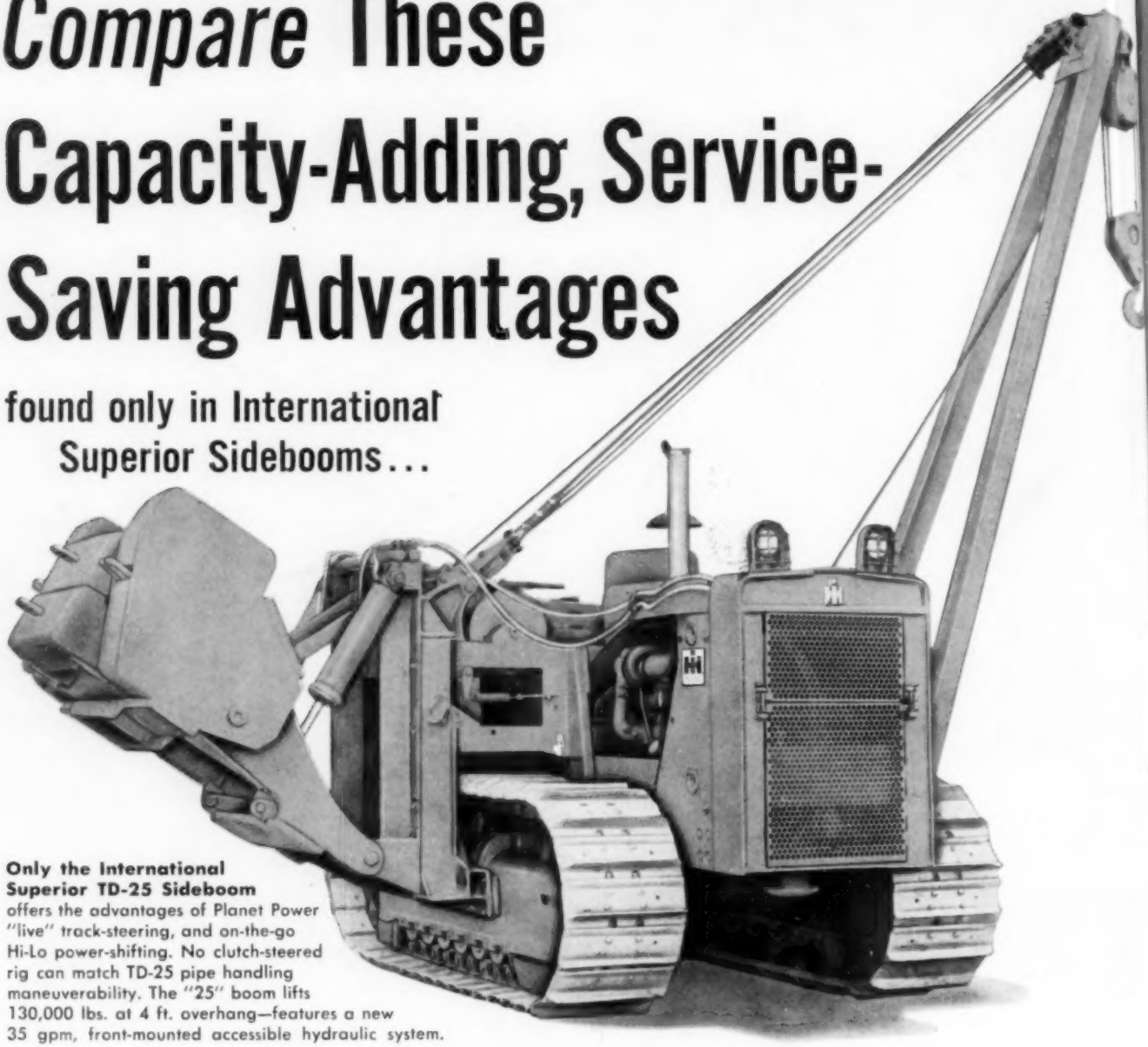
Steel

*SIZES AND WEIGHTS AVAILABLE

O.D.	Wall	Wt. Per Ft.
4½	.125″	5.84
	.142″	6.61
	.156″	7.25
	.188″	8.64
	.219″	10.00
	.237″	10.79
6⅝	.156″	10.78
	.188″	12.89
	.219″	14.97
	.250″	17.02
	.280″	18.97

Compare These Capacity-Adding, Service-Saving Advantages

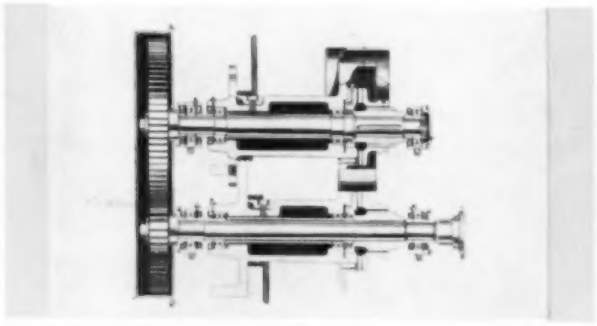
found only in International Superior Sidebooms...



Only the International Superior TD-25 Sideboom offers the advantages of Planet Power "live" track-steering, and on-the-go Hi-Lo power-shifting. No clutch-steered rig can match TD-25 pipe handling maneuverability. The "25" boom lifts 130,000 lbs. at 4 ft. overhang—features a new 35 gpm, front-mounted accessible hydraulic system.

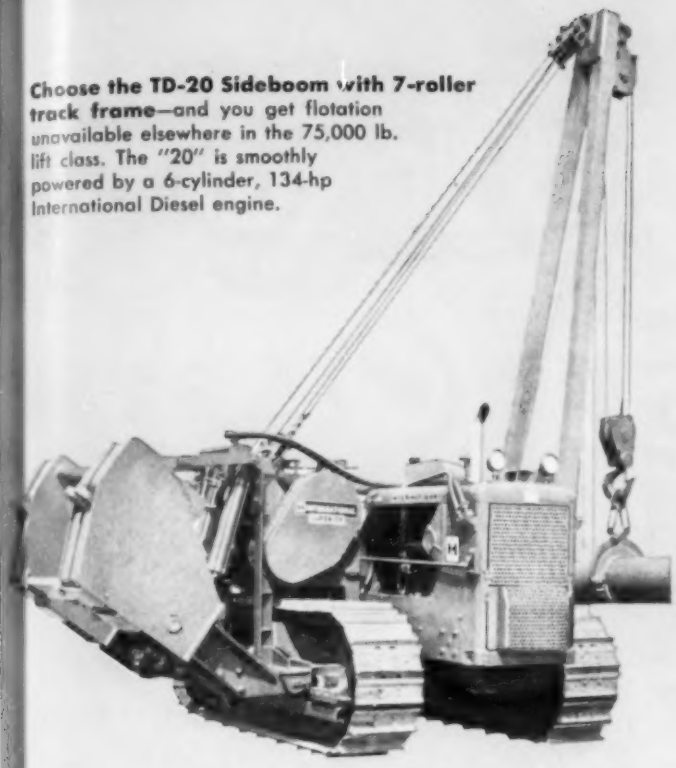
Match key International Superior Sideboom exclusive advantages against competitive rigs. See how these far-ahead features make you extra money all the way, from increasing rig availability to prolonging cable life!

See how you get more for your money and earn more with what you get in International Superior Sidebooms. And compare mobility, flotation, and ease of control to any other make. Let your International Superior Distributor give you an "on-the-line" demonstration.

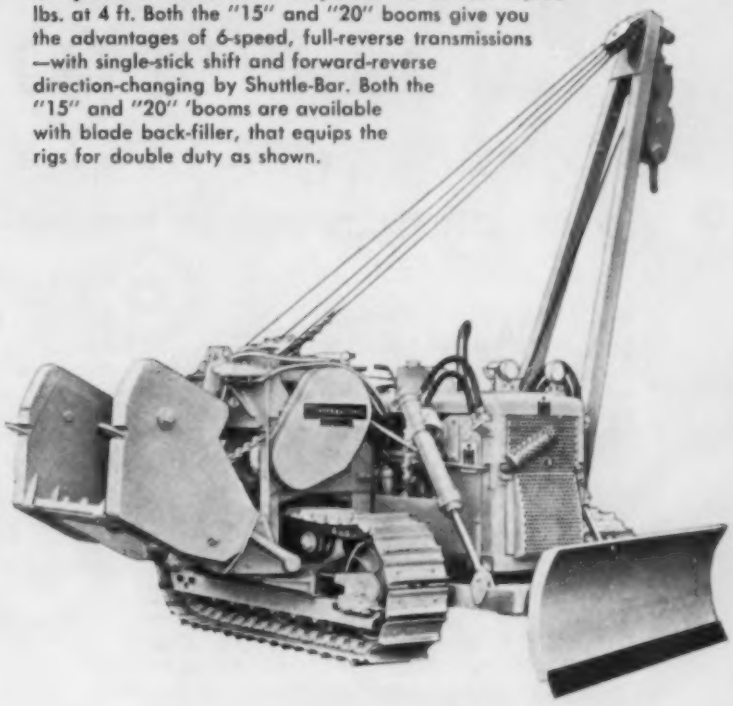


Individually-mounted drum shafts. On TD-25, TD-20, and TD-15 'booms, the load and boom cable drum shafts are individually mounted on separate, short-length large-diameter, alloy steel shafts. Sectional view of TD-20 design shows how these quiet-running gear-driven drums revolve on large, self-aligning anti-friction bearings—for long, trouble-free life. This design simplifies replacement of worn parts. Pipeliners the country over have proved that direct center-to-center cable pull from boom and load sheaves to drum assure substantially greater sheave and cable life.

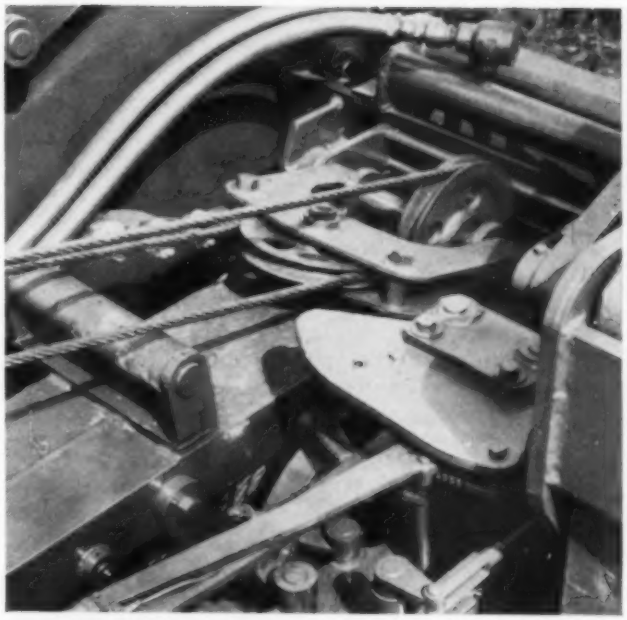
Choose the TD-20 Sideboom with 7-roller track frame—and you get flotation unavailable elsewhere in the 75,000 lb. lift class. The "20" is smoothly powered by a 6-cylinder, 134-hp International Diesel engine.



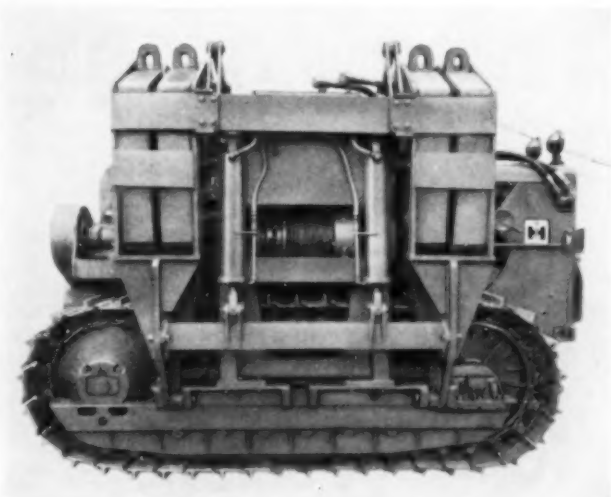
Only the International Superior TD-15 lifts 46,500 lbs. at 4 ft. Both the "15" and "20" booms give you the advantages of 6-speed, full-reverse transmissions —with single-stick shift and forward-reverse direction-changing by Shuttle-Bar. Both the "15" and "20" booms are available with blade back-filler, that equips the rigs for double duty as shown.



Fleeting Sheave Cable Life Protection. Only International superior Sidebooms give you the cable life-extending design of fleeting sheaves. You get fleeting sheaves on load and boom lines to distribute cable evenly on the drums and thus prevent "cable-killing" crushing and piling. Results: longer cable and sheave life, lower operating cost, less service.



Spread-speeding counterweight switching. International Superior Sideboom quick-change counterweights are the industry's easiest to change. Convenient lift eyes in the cast blocks assure that counterweighting can be quickly changed to match changing lift and terrain conditions—for spread-speeding operating efficiency and safety.



International Harvester Company, Chicago 1, Illinois

INTERNATIONAL®

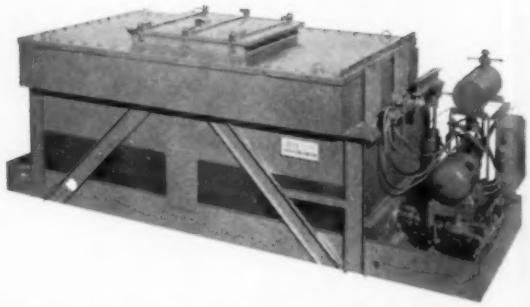
SUPERIOR®

CROSE-LITTLEFORD
PIPELINE KETTLES

WITH MORE FEATURES FOR SPEED AND EFFICIENCY

- SWEEP ARM AGITATOR HYDRAULICALLY DRIVEN
- SELF-THAWING DRAW-OFF VALVE
- LOW CENTER OF GRAVITY
- LARGE CAPACITY
- EXTRA LARGE LOADING DOOR
- INSULATION
- UNITIZED CONSTRUCTION
- BURNER — Safe, low pressure type.
- POWER UNIT — Self-starting air cooled engine.

CROSE-LITTLEFORD PIPELINE KETTLES ARE AVAILABLE IN THREE SIZES: 10-BARREL, 23-BARREL, OR 30-BARREL CAPACITY. ALSO, 75-GAL., 165-GAL., 225-GAL., AND 325-GAL. PATCH KETTLES AVAILABLE.



NEW SKID-MOUNTED KETTLE FOR STATIONARY YARD WORK
WRITE FOR COMPLETE DETAILS

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Authorized by A.P.I. under Std. 5L and 5LX where applicable

high frequency, resistance welded

The API monogram on Valley lightwall pipe means highest quality, because Valley pipe meets the standards of the American Petroleum Institute.

Closer and more convenient, too! Valley has the only pipe mills in the Great Plains—500 miles closer to midwestern and Rocky Mountain oil and gas fields.

Sizes 6 5/8" to 16" Wall Thickness to .219

write or call Dept. L

VALLEY MANUFACTURING COMPANY
VALLEY, NEBRASKA

IN CORROSION PREVENTION

BITUMASTIC
REG. U. S. PAT. OFF
HOT & COLD APPLIED COATINGS

Carey
PIPELINE FELT, PADDING & GLASS PIPE WRAP

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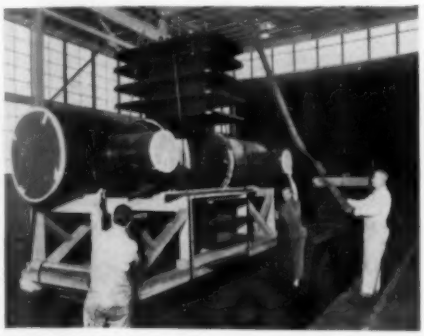
MAVOR • KELLY COMPANY

M & M BUILDING • HOUSTON • CA 2-2203
6101 1038 4th Street • Gretna, La. • FOrest 1-1861

ment of the Stranducer wires is very slight, but precisely proportional to the degree of shaft rotation.

The ElectroniK 17 comes in three basic models—strip chart recorder, circular chart recorder and circular scale indicator. To convert the unit from strip chart recorder to circular chart recorder or scale indicator, only the display module has to be changed. The drive module and case module are common to all three instruments.

For more data, circle **No. E2 on** Readers' Service Card, last page this issue.

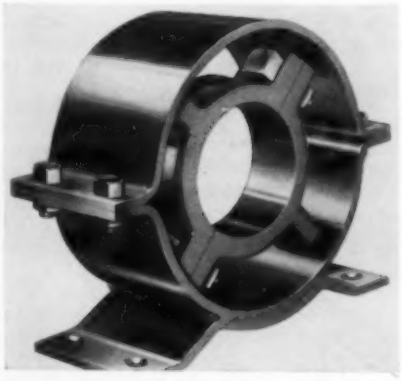


Gate Valve

Grove Valve & Regulator Company has developed a full-opening 36-inch mainline gate valve for use on the 36-inch Alberta to California gas pipe line. The valve, weighing 28,000 pounds and standing about 20 feet high, incorporates all features of Grove's Seal-O-Ring design.

(This item supplements Grove Valve & Regulator Co. data on pages 177-192 of the Pipe Line Catalog, Third Revision.)

For more data, circle **No. E3** on Readers' Service Card, last page this issue.



Pipe Guides

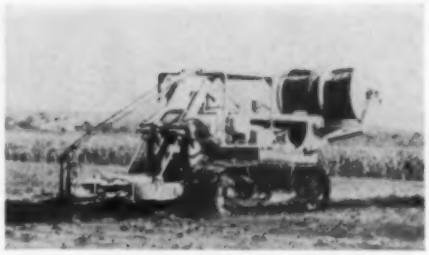
Flexonics Corporation has introduced a new line of pipe alignment guides and roller type supports as an adjunct to the company's expansion joints. The guide consists of a cast steel segmented spider, sized to pipe from ¾-inch to 24-inch normal size. Spider is clamped to the pipe and the guiding cylinder is securely fixed to the supporting structure. The spider provides clearance for complete insulation through the guide. Supports are constructed entirely of steel. A formed steel spacer provides clearance for insulation, provides better support by increasing bearing area and relieves the pipe of direct contact with the steel roller. Units are available for pipe from ¾-inch to 14-inch; larger sizes available on special order.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.

Cable Laying Attachment

A cable laying attachment for all models of Caterpillar track-type tractors equipped with hydraulic control unit is announced by Kelley Products Division of Crutcher, Rolfs, Cummings, Inc. The cable layer will lay any cable or wire up to 3½-inch at depths ranging from a 12-inch minimum with the D4 to a 72-inch maximum with the D9 tractor.

Laying shank is placed far enough behind the tractor to allow unrestricted maneuvering without deviating from the cable line and close enough to provide control of depth and position. Vertical movement of the tool bar is attained by two 7-inch hydraulic cylinders with 48-inch strokes. Lateral movement permits offset laying within 24 inches of paving, building, etc. Cable reel carriers, front



mounted, can be custom engineered for specific applications. Full, 7,000-pound reels of cable are automatically unreeled by drag or pull on the line. In use the layer has averaged about a mile of cable per hour.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

Irish CASING SEALS

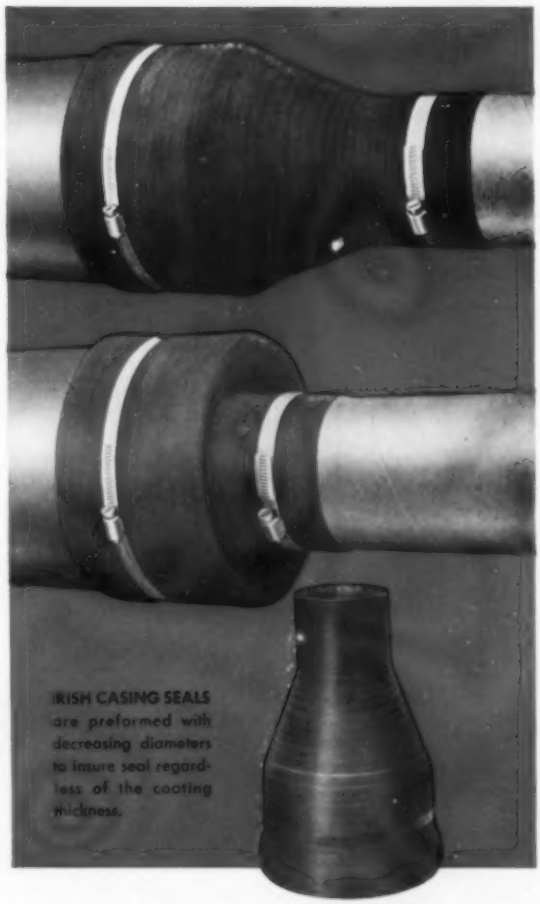
For Highway and Railroad Crossings

Higher Quality Material, Greater Flexibility, Extra Strength

Rugged, resilient, easy to install, **IRISH CASING SEAL** gives the best possible protection from moisture and other corrosive elements. Lasts years under ground!

IRISH CASING SEALS are made from one of the most elastic compounds ever manufactured — **60 Durometer Live Neoprene** — giving it maximum flexibility with the ability to retain its normal tapered shape. Fits tightly around all casing — regardless of the position of the pipe. Extra long in case pipe is off-center. IRISH SEALS form a tight bond even on out-of-round casing.

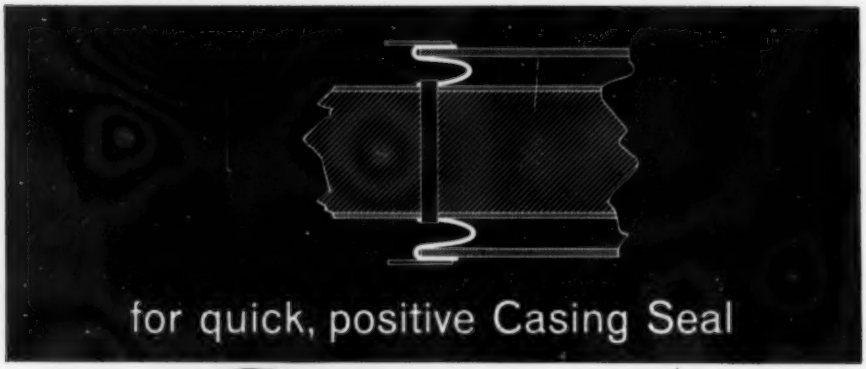
To install **IRISH CASING SEAL** all you do is slip it over the casing and into the desired position. No sweat! No strain! Then tighten with the STAINLESS STEEL BANDS, equipped with screw-type fasteners, which come with every seal. A screwdriver does the trick! No special glue or cement is required. Available in any pipe size combinations. All sizes available with zippers.



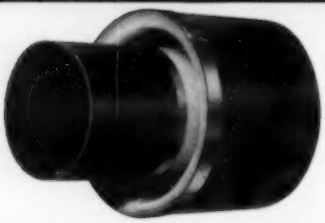
IRISH PIPE LINE SUPPLY CO.

Phone ME 5-2188, 2504 Flournoy-Lucas Road

SHREVEPORT, LOUISIANA



for quick, positive Casing Seal



NO EDGE CUTTING,
BACK-FILL DAMAGE OR
ROCK SHIELDS

more economical
simple, fast installation
compensates for pressure
from either direction

USE **GREENHEAD** CASING SEALS

3800 West Alabama, Houston 27, Texas, Phone: MOhawk 7-3356.

Vermeer 4-T POW-R-DITCHER

Rugged, Low Cost Ditcher Digs 6"-14" Wide, 4½' Deep

This highly maneuverable 4T POW-R-DITCHER is only 46" wide . . . fast . . . and can handle most ditching jobs at a fraction of the cost of larger, more expensive units. The finest ditcher buy for low cost investment, low maintenance and high production.

IDEAL FOR LAYING GAS, WATER AND CABLE LINES AND FOR DIGGING HOME FOUNDATION FOOTINGS

PICK THE POW-R-DITCHER TO FIT YOUR NEEDS

524T

W-3

W-1

3P

Please send me FREE information and prices on the complete Vermeer line of self-propelled POW-R-DITCHERS.

NAME .....

FIRM .....

ADDRESS .....

CITY ..... STATE .....

☐ Also include information on new Vermeer hydraulic back filler.

VERMEER MANUFACTURING COMPANY

1403 WASHINGTON • PELLA, IOWA

Utility Crane

Link-Belt Speeder Corporation has announced a new rubber-tired self-propelled 35-ton utility crane. The UC-98A has power hydraulic controls, power load-lowering (reversing) clutches for either or both main drums, safety boomhoist lever kick-out device and gasoline or diesel engines with hydraulic couplings or torque converters.

Both front and rear double-box outriggers and sliding beams are removable. Hydraulic outriggers are available. Other features include planetary rear axles and full fenders.

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

Line and Fittings

Steel line and fittings for pneumatic or hydraulic service featuring leak-proof metal-crush seal and working pressures up to 16,000 psi have been developed by Cardair Division of Marmon-Herrington, Inc.

Two sizes are available, 1-inch with a ⅝-inch diameter flow passage and ¾-inch with a ⅜-inch diameter flow passage. The flow passage of both sizes are full unrestricted diameter in both the line and fittings.

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

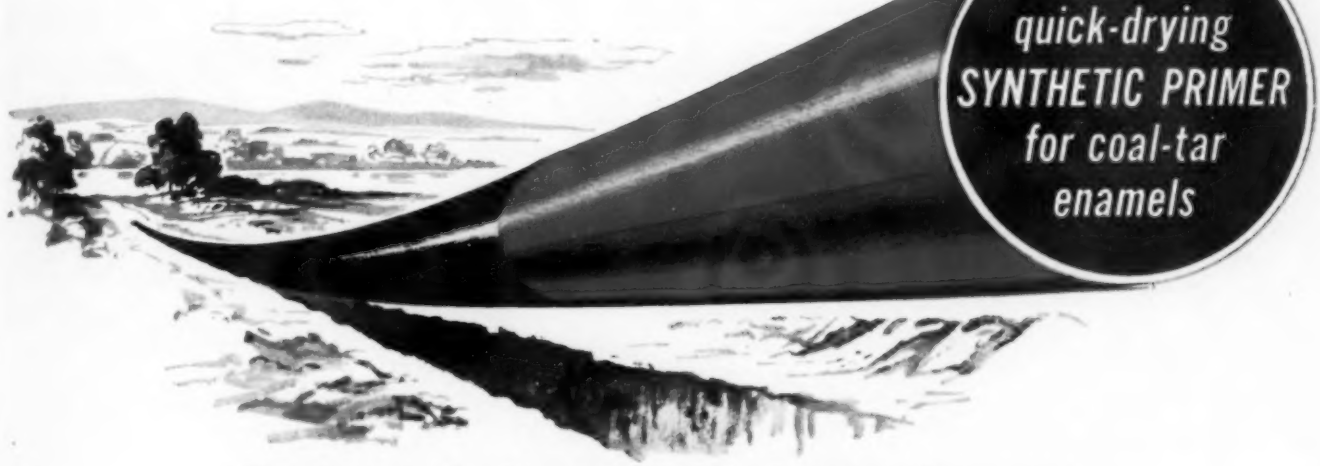
Insulated Bushings

A line of fiberglass reinforced nylon bushings, designed for use in cathodic protection, has been introduced by Central Plastics Company. Available from one-half through two-inch sizes, the bushings have excellent resistance to cold flow and have molded hex head equal to a standard bushing. Black non-metallic color is designed to improve weathering characteristics.

(This item supplements Central Plastics Company data on page 65 of the Pipe Line Catalog, Third Revision.)

For more data, circle **No. E8** on Readers' Service Card, last page this issue.

REILLY REDHEAD



Translucent red color permits visible detection of any areas missed in cleaning... any areas not covered by primer... any areas not covered by enamel!

New Reilly Redhead, a quick-drying synthetic primer for hot coal-tar enamels, is compounded specifically for difficult drying conditions where initial high bond strength is mandatory. Reilly Redhead provides initial bond strengths up to several times greater than typical non-synthetic primers and fractionally greater strength than Reilly coal-tar base primers X-1 and X-10.

Reilly Redhead dries to touch in 5 to 10 minutes after application to metal surfaces at 70°F. where relative humidity does not exceed 70% and is free from organic solvent vapors. It dries hard, ready to accept enamel, within two hours under the same conditions.

Other important advantages are:

- *Offers greater film life; protects clean surface several weeks if enameling is delayed.*
- *Conforms to specifications under consideration by A.W.W.A. and governmental agencies.*
- *Performs advantageously with all Reilly plasticized hot application enamels.*
- *Is available in 55, 5 and 1-gal. containers, in carloads, carloads mixed with enamel, or less than carload, shipped from Indianapolis, Ind. or Lone Star, Tex.*

Write today for complete information on new Reilly Redhead, the quick-drying high bond strength synthetic primer. See how you can use Reilly Redhead profitably in your operations.

Reilly TAR & CHEMICAL CORPORATION

TAR PRODUCTS DIVISION 1615 Merchants Bank Building
Indianapolis 4, Indiana

Copon gives more pipeline thru-put...up to 6% more!

The industry's only field tests prove it!

ONE epoxy coating for internal coating of pipelines has been field tested on large diameter gas transmission lines. Just one. That is Copon.

The results of the industry field tests show that deliverability can be increased — "an additional one to six per cent increase directly attributable to internal coating."

We'll be glad to send you reprints of the feature articles in *Pipe Line Industry* and *Gas* which report these tests in detail.

The increase in pipeline thru-put revealed in these tests is a welcome *bonus* you get when you coat with Copon. Primary benefits of Copon internal pipe coatings include maximum corrosion protection — reduced maintenance costs . . . delivery of cleaner products.

Special applications are available for coating dehydrated gas lines, crude petroleum product lines, salt water or fresh water lines, and oil well tubing and casing.

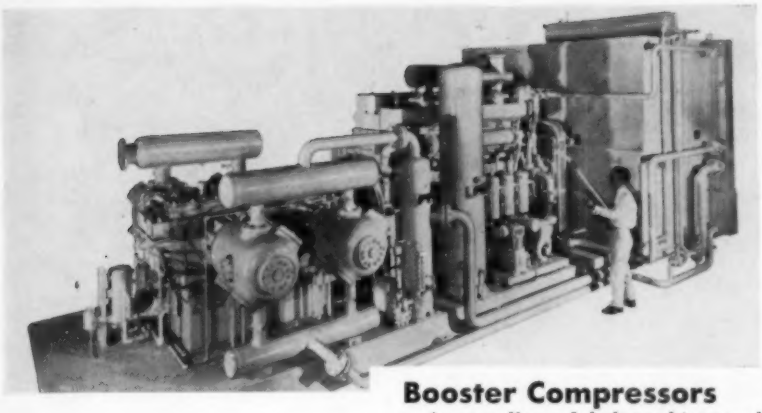
If you're interested in increased capacity for your transmission lines, write or call for the pipeline industry's report on tests that prove *Copon* can give you more thru-put.

Use Copon to coat submerged or buried lines. Also on individual joints for new construction.

FOR CORROSION CONTROL

Copon®

GENERAL OFFICES • POST OFFICE BOX 1113 • TELEPHONE OR 2-6541 • HOUSTON 1, TEXAS



Booster Compressors

A new line of balanced/opposed compressors for gas gathering, lifting, repressuring and booster service has been developed by The White Diesel Engine Division of The White Motor Company. The two-cylinder (W-62) and four-cylinder (W-64) compressors have been designed for continuous, unattended, heavy duty service and have been engineered for direct drive with White Superior natural gas engines.

Engine compressor units are available from 200 to 1,000 bhp operating at 600 to 900 rpm with the compressor using a 6-inch stroke. The two-cylinder compressor covers a range from 200 bhp, with the 6G-510 engine, to 635 bhp, with 8G-825 gas engine. Four-cylinder compresser rates up to 1,000 bhp with supercharged 8GX-825 engine.

(This item supplements White Diesel Engine Division data on pages 569-572 of the Pipe Line Catalog, Third Revision.)

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

Pig-Sig II

T. D. Williamson's Pig-Sig II, scraper passage indicator, is now available with bi-directional trigger designed for use in meter proving loops or in lines for scraper travel in either direction. In addition to visual and electrical signals, the unit is also available with pneumatic control with automatic reset for actuating pneumatic control systems.

Available as optional attachment is an automatic counter which counts and records scraper passage. The pig-sig comes with visual indicator, electrical control or pneumatic control with automatic reset, extended or non-extended. The cutaway drawing shows bi-directional trigger.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.

L. C. RUSSELL COMPANY

INTERNAL PIPE COATING CONTRACTORS

★ *Increased Thru-put*

★ *Cuts Maintenance Cost*

★ *Storage Protection*

★ *Cleaner End Products*

★ *Protects Against Corrosion*

Internal Cleaning and Coating at or Near Mill
C-R-C Patented Machines

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BEAUMONT, TEXAS
Telephone - Nite or Day - Terminal 5-4535

GUARD

COMPRESSORS!
ENGINES!
PUMPS!

The Servis
OIL METER
measures
"make-up" Oil

The Servis Oil Meter gives you a constant and accurate measurement of oil consumed. It pin-points trouble before it happens. It completes the automation of your compressor or pumping station.

Now in service at compressor and pumping stations of many gas and oil transmission companies . . . it has proved efficient and accurate the year around in all climates.

Install 3 meters to measure (1) total "Make-up" in the crankcase, (2) total consumption of the Power Cylinder Lubricators and (3) total consumption of the Compressor Cylinder Lubricators. No minimum flow requirement. Registers to 9999.9 gallons and then repeats.

Write for Literature

SERVICE RECORDER COMPANY
1015M Rockwell Ave., Cleveland 14, Ohio

Specializing in Measuring and Recording Instruments for 50 Years.

first *FOR REFERENCE . . .*

A *one-volume reference library* for purchasing and specifying. That's the best way to describe the only comprehensive catalog data file published specially for the Pipe Line Industry. Convenient to handle, thoroughly indexed, it is saving time and money for thousands of pipe line men.

first *FOR INFORMATION ON MANUFACTURERS AND SERVICE COMPANIES*

Included in 170 equipment and service companies' data in PLC, there are more than 1,675 manufacturers' representatives and sources of supply listed.

●

first *FOR INDIVIDUAL EQUIPMENT AND SERVICE ITEMS*

There are more than 11,000 equipment and service items cataloged, with detailed information on specifications, installation, operation, maintenance, service—an entire library of useful reference.

●

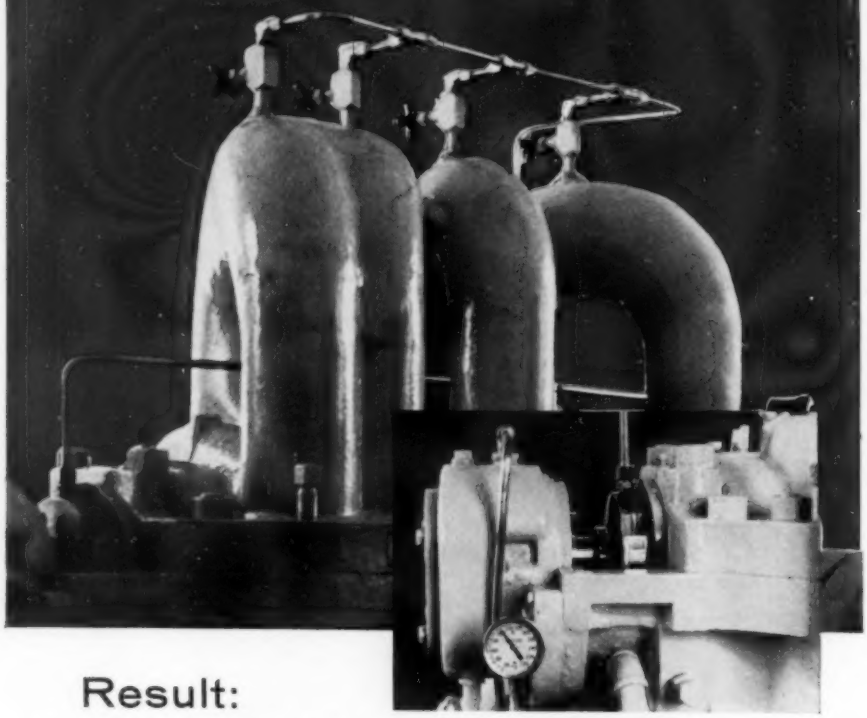
first *FOR CONSTRUCTION EQUIPMENT AND SERVICE*

Pipe Line construction and service items listed in PIPE LINE CATALOG exceed 500...an invaluable aid to office and field specifications and purchases.

●

When you are ready to buy or specify, or if you just want planning information, look first in PIPE LINE CATALOG.

*Atlantic Pipeline standardizes on Borg-Warner Mechanical Seals with exclusive "Pre-setting Ring"**

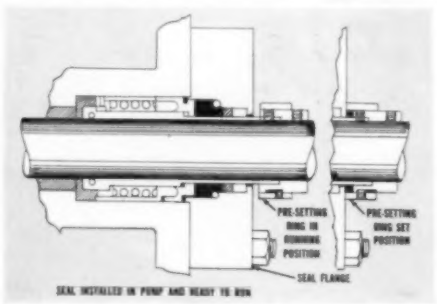


Result:
Up to 50% less maintenance

Since their first installation over four years ago, Atlantic Pipeline Company's Eastern Division has standardized on Borg-Warner Mechanical Seals on main line, booster and calibrating pumps. To date, experience with 26 pumps shows up to 50% less frequent maintenance; a marked decrease in product losses through leakage and evaporation; reduction of hazardous fumes; plus the economy of standard, interchangeable seals. Seals at Atlantic Pipeline's Product System operate under all conditions from inches of vacuum to 1300 psi, with *no pump down time due to seal failure!*

Here's how it works:

Complete Seal unit slips onto shaft — bolts to the stuffingbox. Pre-setting ring is then locked in running position to assure perfect spring tension.



*Pat. Pending

Borg-Warner Mechanical Seals

A PRODUCT OF B-W BORG-WARNER

DIVISION OF BORG-WARNER CORPORATION

P.O. Box 2017, Terminal Annex, Los Angeles 54, California

Literature

Pipe Wrap

Containing details about Fiberglas inner and outer wraps, a catalog has been published by Owens-Corning Fiberglas Corp. Micro-photos in the booklet show how glass yarns and fibers are bonded to make tough and resilient Fiberglas pipe wraps. Other photos illustrate the application techniques both at the job site and in the mill.

Technical tables are included as a guide to the proper thicknesses, widths, laps and other information necessary for specific jobs. Dimensions, physical properties and other specifications of the wrap products are included in charts.

To get a copy, circle **No. E11** on Readers' Service Card, last page this issue.

Epoxy Primer

A new heavy duty epoxy type primer containing lead silico chromate, iron oxide and leafing type pigments, is described in a bulletin released by Wisconsin Protective Coating Corp.

The coating may be used as a combination primer and coating and applied to a thickness of 4 to 5 mils in one spray coat application. Physical properties, application procedures and uses are described in the technical bulletin.

To get a copy, circle **No. E12** on Readers' Service Card, last page this issue.

Alloy Valves

A 16-page bulletin which describes and illustrates the Aloyco line of corrosion-resistant valves has been issued by Alloy Steel Products Company. The brochure summarizes the types of alloys in which each valve is available from stock, as regularly manufactured, or on special order.

Included are engineering specifications of valves and listing of alloy materials, with chemical composition ranges and minimum mechanical properties.

To get a copy, circle **No. E13** on Readers' Service Card, last page this issue.

Casing Insulators

A six-page brochure has been published by Greenhead, Inc., describing the pipe slings and road crossing casing insulators. Included in the brochure are specifications and graphic material on cathodic protection test stations, field jointers, temporary pipe plugs, plastic casing seals and other pipe line accessories.

To get a copy, circle **No. E14** on Readers' Service Card, last page this issue.

CLASSIFIED ADVERTISING

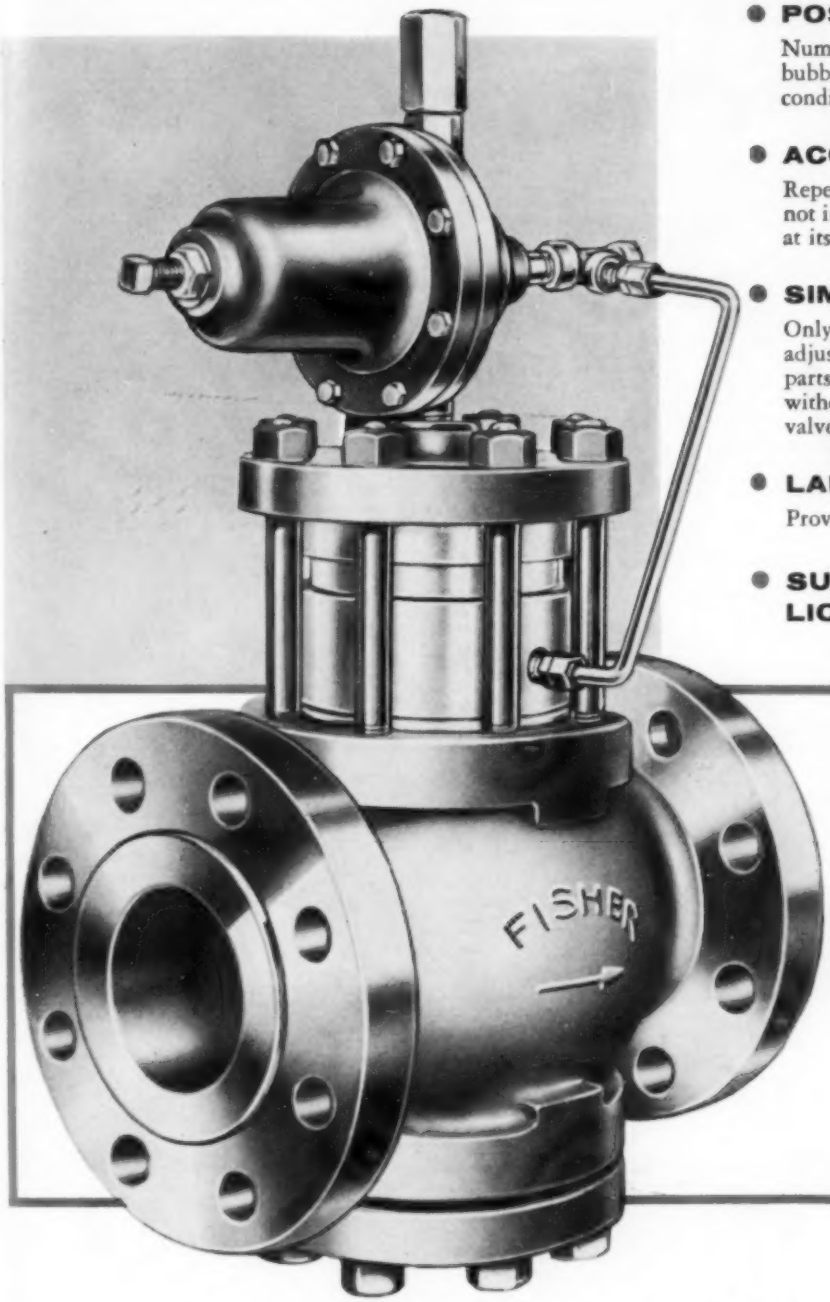
FOR SALE

■ Carloads or truckloads of 4x4-6' rough hardwood $65.00 per thousand feet. Immediate delivery. Please phone or wire your orders. Gaiennie-Wholesale Lumber, Inc., P. O. Box 1774, Shreveport, Louisiana.

For trouble-free service on high pressure lines

NEW FISHER 404

high pressure relief valve



- **POSITIVE SHUT-OFF**
  Numerous field tests show that the 404 gives bubble tight shut-off under all pressure drop conditions.
- **ACCURATE AND DEPENDABLE**
  Repetitive operation, frequent or infrequent, does not interfere with its ability to relieve consistently at its predetermined setting.
- **SIMPLE AND COMPACT**
  Only one moving component in main valve. Only adjustment is pilot spring setting. All internal parts can be removed or inspected in minutes without special tools and without removing the valve body from the line.
- **LARGE CAPACITY**
  Provided by full port body and pilot operation.
- **SUITABLE FOR GAS OR LIQUID RELIEF SERVICE**

SPECIFICATIONS

Body Sizes—2″ Screwed; 2″, 3″, 4″, and 6″ Flanged.

Body Material—Cast Steel.

Valve Disc Material—Composition.

Body Trim—316 Stainless Steel.

Relief Pressure Ranges—30 to 600 psi.

FOR COMPLETE DETAILS WRITE FOR BULLETIN P-404

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / Rochester, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIP. CO., CORAOPOLIS, PA.

FISHER® Controls

SINCE 1880

SKINNER-SEAL
PIPE JOINT CLAMP STOPS LEAKS
at joint where pipe is screwed into fitting

SKINNER-SEAL
PIPE JOINT CLAMP stops leaks at joints where pipe is screwed into fitting. Any temperature—any pressure up to 2,000 pounds. Saves the cost of tearing out and renewing leaky fittings. Prevents shutdowns. In stock at most oil supply stores.

SKINNER-SEAL
EMERGENCY PIPE CLAMPS for safe, sure, lasting repair of splits and rust holes in pipe. No pressure too high. Anyone can apply in a few moments. Made in all sizes, ½" to 12" for steel and C.I. pipe. Stocked by practically all oil supply stores.

Complete line of Repair Clamps. Send for Catalog 54!

M. B. SKINNER CO.
SOUTH BEND 21, INDIANA

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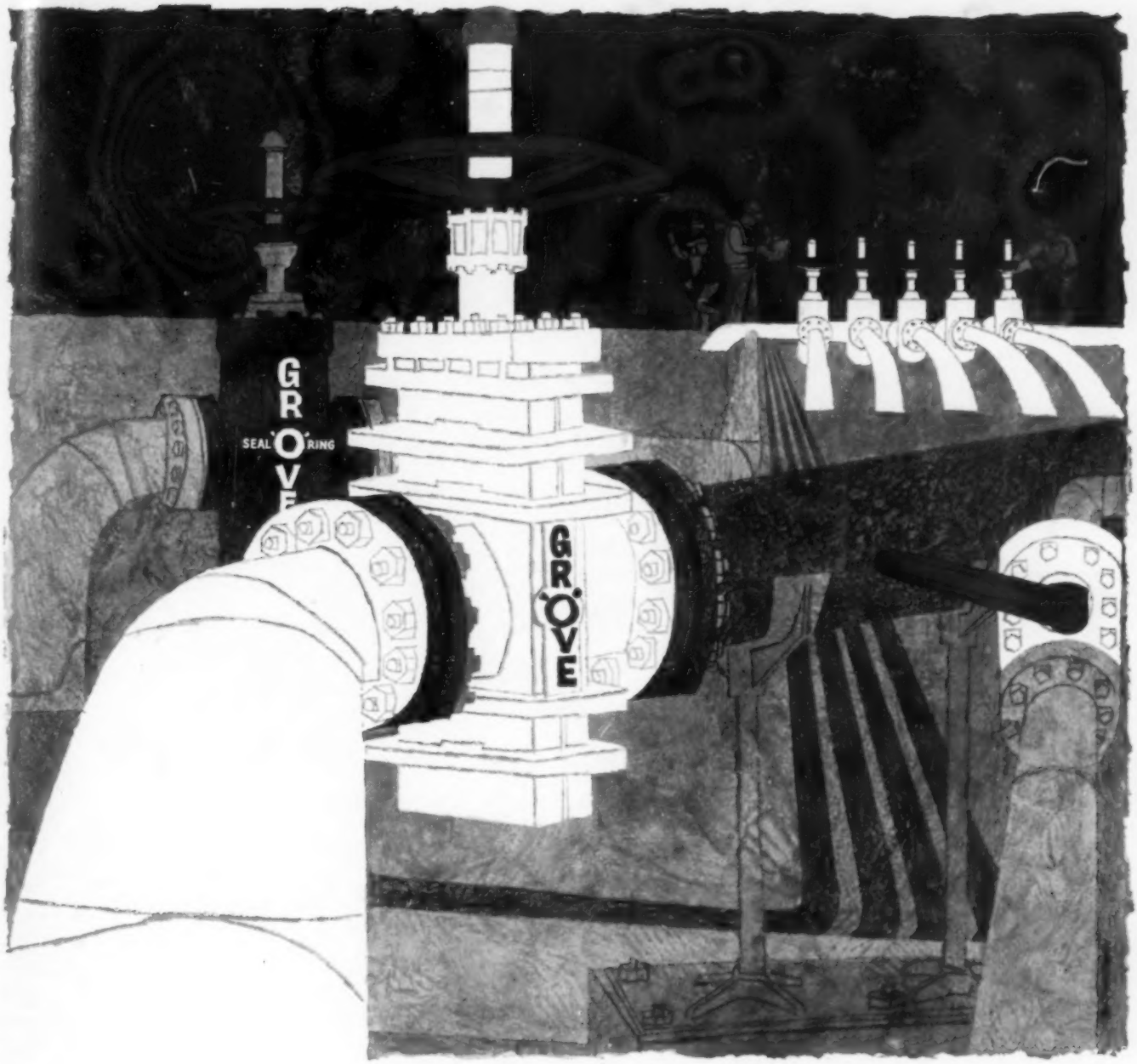

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